DOCUMENT RESUME

ED 063 992 24 RC 006 201

AUTHOR Alford, Roy W., Jr.
TITLE Teaching Mathematical Concepts to Rural Preschool Children Through a Home-Oriented Program.
INSTITUTION Appalachia Educational Lab., Charleston, W. Va.
SPONS AGENCY National Center for Educational Research and Development (DHEW/OE), Washington, D.C.
PUB DATE Jun 70
CONTRACT OEC-3-7-062909-3070
NOTE 168p.; Doctor's dissertation submitted to University of Virginia, Charlottesville, Virginia

EDRS PRICE MF-$0.65 HC-$6.58
DESCRIPTORS *Disadvantaged Youth; *Doctoral Theses; *Early Childhood Education; Educational Television; Home Visits; *Mathematics Instruction; Mobile Classrcoms; *Rural Education; Standardized Tests
IDENTIFIERS *Appalachia

ABSTRACT

Preschool children (ages 3, 4, and 5) participating in the Appalachia Preschool Educational Program were studied to determine if mathematical concepts could be effectively taught through a preschool program accessible to rural children. The 34-week program consisted of 3 elements: (1) a daily half-hour television broadcast, (2) weekly home visitations by trained paraprofessionals, and (3) a traveling classroom which provided for weekly group experiences. Data were collected on 121 children from southern West Virginia divided into 4 treatment groups with approximately equal numbers of children of each sex and age level in each group. Group 1 experienced intervention through television broadcasts, home visits, and traveling classroom; group 2, through television broadcasts and home visits; group 3, through television broadcasts only; and group 4 experienced no intervention. The experimental groups performed significantly better than the control group on the following mathematical behaviors: number terms, geometric figures, cardinal number and sets, and matching forms. Behaviors that did not differentiate among the groups were knowledge of age and birth date, cause and effect, classification, positional and spatial terms, and time relationships. It was concluded that the television element was effective only in combination with one or both of the other elements. Recommendations are presented for program revisions, for a follow-up study of the same children, and for application to other rural areas. Appendices include the data-gathering instruments, summary statistical tables, and a list of television broadcasts with mathematical content. (FF)

TEACHING MATHEMATICAL CONCEPTS TO RURAL PRESCHOOL CHILDREN THROUGH A HOME-ORIENTED PROGRAM

A Dissertation

Presented to the

Faculty of the School of Education

University of Virginia

In Candidacy for the Degree of

Doctor of Education

by

Roy W. Alford, Jr., B. S., M. A.

June, 1970

ACKNOWLEDGEMENTS

Appreciation is expressed to Dr. Rose Mukerji, Brooklyn College, for her assistance in formulating the structure of the Appalachia Preschool Education Project, and to Dr. Frank H. Hooper, West Virginia University, for his advice on the testing of cognitive skills.

A special thanks is extended to Dr. James T. Ranson, Appalachia Educational Laboratory, who gave valuable help with the statistical procedures used in the study.

The participation of the children and parents in the project upon which the study was based must be noted. Without them, there would have been no study.

To my advisor, Professor William C. Lowry, who has been so supportive and helpful throughout my doctoral program, my gratitude and appreciation is expressed.

Appreciation and thanks are extended to Dr. Ralph Cherry and Dr. Ertle Thompson, committee members, who have offered encouragement over a period of years.

Finully, a special word of thanks to my wife, Alice, for her encouragement, her support, and her help; the writer is appreciative and grateful.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

INTRODUCTION

The Appalachia Educational Laboratory is one of fifteen regional laboratories established and funded under Title IV of the Elementary and Secondary Education Act. Regional laboratories operate under guidelines formulated by the Division of Educational Laboratories of the United States Office of Education. Their stated purpose is to conduct educational research and research related activities, to carry out the training of individuals for leadership of such activities, and to assure the continuous and intensive implementation of educational improvements based on that research. The Appalachia Educational Laboratory, with offices in Charleston, West Virginia, serves a region covering all of West Virginia and portions of Virginia, Tennessee, Kentucky, Ohio, and Pennsylvania.

The antecedents of the problems of Appalachia and of its educational problems in particular have been rather thoroughly documented elsewhere, so no attempt will be made to delineate them here. For a complete statement of antecedents and needs, the reader may refer to the Program Prospectus of the Appalachia Educational Laboratory.[1] The mountainous terrain, sparse population, and poor transportation system combined with an insufficient tax base leading to shortages of teachers, buildings, and equipment, are all contributing factors which might be mentioned.

The Appalachia Educational Laboratory is committed to the idea that conventional approaches to the change and improvement of education will not suffice to provide the major breakthrough in education that is needed to overcome the problems

---

[1] Appalachia Educational Laboratory, Inc., Program Prospectus (Charleston: 1967), pp. 4-11. (Mimeographed.)

of Appalachia.[2] It is committed to provide access to quality education in Appalachia through the extensive use of modern technology, new instructional media, and mobile educational facilities with the cooperative efforts of local school systems, state departments of education, and colleges and universities.[3]

Four areas have been identified for major efforts toward providing or improving opportunities for children: early childhood education, vocational guidance, language development, and course and curriculum adaptation. Proposed solutions in each area are designed to fit within the overall strategy for amelioration proposed by the Laboratory as described above.

A portion of the effort in early childhood education is described in this paper. The work was done pursuant to a contract with the Office of Education, United States Department of Health, Education, and Welfare through the Appalachia Educational Laboratory, Inc., Contract No. OEC-3-7-062909-3070. Points of view or opinions stated are those of the author, and do not necessarily represent official Office of Education or Appalachia Educational Laboratory position or policy.

---

[2] Ibid., p. 11.

[3] Ibid., p. 12.

CHAPTER I

THE PROBLEM

Early intervention into the lives of culturally disadvantaged children with an educational program designed to enrich their environment has been proposed as an operational strategy by many people, from Montessori to Bloom.[1,2] The growth of preschool programs has been rapid. Hess, in his survey of preschool programs (not including Head Start), found that, of almost seventy cities which had preschool programs in operation, over half had been established within the two years previous to his study.[3] The national investment in the Head Start program is also indicative of the importance attached to preschool programs in the United States.

The majority of the children of Appalachia live in rural areas where they are victims of general isolation and poor transportation conditions. To enroll them in a traditional classroom-oriented kindergarten program would subject them, in many cases, to the hardships of too long a day and too long a trip, even supposing that there would be enough of them to form a class at the nearest school. Appalachia still had, in 1967, more than 532 one-room schools in use.[4] The need for an

---

[1]Fred M. Hechinger, Pre-School Education Today (New York: Doubleday and Company, Inc., 1966), pp. 58-60.

[2]Lester D. Crow, et al., Educating the Culturally Disadvantaged Child (New York: David McKay Company, Inc., 1966), pp. 118-119.

[3]Hechinger, op. cit., p. 8.

[4]Roy W. Alford, Jr., "One-Room Schools in Appalachia" (Charleston: The Appalachia Educational Laboratory, Inc., 1967). (Mimeographed)

alternative to the classroom kindergarten to supply a preschool program for these children was evident.

One of the major areas of cognitive behavior involves the understanding of mathematical concepts. Uzgiris points out that,

> At around the age of seven, Piaget finds reasoning becoming operation in that it attains the characteristics of logical and mathematical operations. Although this early operational reasoning is still limited to concrete situations, it nevertheless depends on the availability of invariant concepts or conservations. The most general of these concepts are the ideas of number, space, time, substance, weight, volume, etc.[5]

The child is in the process of developing these concepts in his preschool years. Bloom contends that one-third of all a person learns has been learned by the time he is six.[6]

The need for a means to effectively teach mathematical concepts to rural preschool children was evident.

The Appalachia Educational Laboratory has developed a preschool program for rural children of ages three, four, and five, which is designed to be presented to them in or near their homes by the means of television, home visitations, mobile facilities, and other media deemed appropriate. The three elements of the program were:

1. A television broadcast, over a commercial channel which was receivable on home sets, lasting one-half hour each for five days a week, a total of 170 broadcasts per year.

2. Home visits by trained paraprofessionals, once each week for approximately one-half hour.

3. A traveling classroom, with a teacher and an aide, which the children, in groups of ten to fifteen, visited once a week for approximately one and one-half hours.

---

[5]Ina C. Uzgiris, "Situational Generality of Conservation," Logical Thinking in Children, (eds.) Irving E. Sigel and Frank H. Hooper (New York: Holt, Rinehart and Winston, Inc., 1968), p. 41.

[6]Benjamin S. Bloom, Stability and Change in Human Characteristics (New York: John Wiley and Sons, Inc., 1964), p. 110.

The program curriculum was built around a set of objectives, expressed in behavioral terms, which were grouped as follows: (1) orienting and attending skills, (2) motor activities, (3) language, and (4) cognition. Many of the behavioral objectives grouped under cognition were derived from mathematical concepts.

It is thought by the Laboratory that this approach will provide a sound preschool program accessible to rural children, and that mathematical concepts will be effectively taught through it.

STATEMENT OF THE PROBLEM

It was the purpose of this study to assess the viability of the Appalachia Preschool Education Program as a means of providing sound and effective preschool experiences in mathematical skills and concepts for rural children.

NEED AND IMPORTANCE OF THE STUDY

The accessibility of preschool education to rural children has been limited. For many years children of the affluent in urban and suburban areas have had nursery schools and kindergartens available to them. More recently children of low income families have had day-care centers and Head Start programs available to them. Some of the factors influencing the enrollment of three-, four-, and five-year-old children in preschool programs was shown in a survey dated October, 1968. Interestingly, race was not listed as a major factor; 33.2 per cent of all white children were enrolled in a preschool program; and 31.9 per cent of all none-white children. When family income was below $3,000 per year, 23.4 per cent of the children were enrolled, but when it was over $10,000 the enrollment jumped to 45.6 per cent.

When the head of the family was unemployed, 29.9 per cent of the children were enrolled in a preschool program, but when he was employed in a farm occupation, enrollment dropped to 21.6 per cent. Comparatively, 28.7 per cent of the children whose fathers were in a manual or service occupation were enrolled, and 41.2 per cent whose fathers were white-collar workers. The place of residence of the child was a major factor. Children living in a metropolitan area (50,000 or more inhabitants) were enrolled at the rate of 36.7 per cent, while only 26.3 per cent of those in non-metropolitan areas were enrolled. Finally, children in the South (which includes most of Appalachia) were enrolled at a rate of 24.3 per cent, while the figures for the other regions are: North Central--35.5 per cent; Northeast--36y0 per cent; and West--40.7 per cent.[17] From this information it would appear that urban and suburban children have preschool programs more accessible to them than do rural children, and that a child in the rural South is at a distinct disadvantage.

Hymes stated that early childhood education had its full share of unsolved problems and listed ten of them. Three of these problems appear to be relevant here: there are not enough programs; the programs in existence are not good enough; and rural programs with excessively long bus rides to school present an added difficulty.[18]

Since it appeared that preschool programs were not equally accessible to all children and that there was an apparent lack of programs for rural children, a study

---

[17]Roy C. Nehrt and Gordon E. Hurd, Preprimary Enrollment of Children Under Six: October 1968 (Washington: U.S. Department of Health, Education and Welfare, 1969). Inside front cover.

[18]James L. Hymes, Jr., Early Childhood Education, An Introduction to the Profession (Washington: National Association for the Education of Young Children, 1968), pp. 40-43.

dealing with a home-oriented preschool program for rural children should supply needed information to the educational profession.

The learning of mathematical concepts was selected for evaluation in this study. Schlinsog wrote,

> When one attempts to write an article on a given topic, it is good practice to examine the literature to see what others are writing. If, however, the topic happens to be mathematics in the kindergarten, there is not much literature to examine.[9] (Emphasis supplied.)

If an attempt were made to include children of three and four years of age with the five-year-olds of kindergarten, very little additional information would be available. To gain a perspective of the amount and type of literature dealing with preschool mathematics over the past several years, consider the following studies.

A listing of doctoral research for 1964 showed twenty-five dissertations under Elementary Mathematics, of which the following three were applicable to preschool children: "An Analysis of the Mathematical Vocabulary of Four- and Five-Year-Old Children," "Mathematical Concepts, Skills and Abilities of Kindergarten Entrants," and "The Prediction of First Grade Reading and Numbers Achievement by Means of Psychological Tests."[10]

Burns and Dessart, in a summary of mathematics investigations for 1965, cited only four papers under the heading of Preschool Level. In essence, each of the four

---

[9]George W. Schlinsog, "More About Mathematics in the Kindergartens," The Arithmetic Teacher, 15:701, December, 1968.

[10]E. G. Summers, "Doctoral Dissertation Research in Science and Mathematics, Report for 1964," School Science and Mathematics, 67:44-50, January, 1967.

authors inventoried the level and/or extent of preschooler's mathematical ability and knowledge. In one paper the author categorized "disadvantaged children" and another author spoke of "psychological and sociological" relationships. A fifth paper mentioned, under the heading Piaget-Oriented, presented a description of children five years of age given various training in conservation of number, length, and substance.[11]

A listing of research on mathematics education, grades K-8, for 1967 included forty-eight journal articles, three of which related to preschool children. One pertained to method or content, and two provided descriptions of mathematical competencies. Dissertation abstracts listed numbered seventy-five, but only six related to preschool children--three on content or method and three descriptive of selected groups.[12]

Glennon and Callahan posed the question, "What is a desirable arithmetic program for kindergarten students?" They referred to three studies which presented the characteristics of children entering kindergarten or first grade, the cognitive development of children, and the effects of cultural deprivation. They also described some of the work of Piaget with young children, as well as that of Dienes and Bereiter.[13]

---

[14] Paul C. Burns and Donald J. Dessart, "A Summary of Investigations Relating to Mathematics in Elementary Education: 1965," School Science and Mathematics, 66: 838-851, December, 1966.

[12] C. Alan Riedesel, Marilyn N. Suydam and Len Pikart, "Research on Mathematics Education, Grades K-8, for 1967," The Arithmetic Teacher, 15: 531-544, October, 1968.

[13] Vincent J. Glennon and Leroy G. Callahan, Elementary School Mathematics (Washington: The Association for Supervision and Curriculum Development, NEA, 1968), pp. 26-27.

It would appear from the above that the following statement might be made concerning research related to mathematics for preschool children. In general there is a lack of research in this area; the available research is mostly descriptive of group characteristics (e.g., entering kindergarten students) and comparisons of groups (e.g., disadvantaged versus advantaged); and there is very little research in content and method for preschool instruction.

One is led to conclude that there is a need for further information on the teaching of mathematical concepts to the rural preschool child. Information on the content of mathematical concepts embedded in preschool instruction and the efficiency with which they have been presented is lacking. This study was designed to add to the body of knowledge in the field. A home-oriented program provides an alternative for classrooms and long bus trips for rural preschoolers. This study assessed the viability of such an approach.

PROCEDURE

The Intervention

The Appalachia Preschool Education Program consisted of three elements: television broadcasts, home visitors, and traveling classrooms. The learning experiences provided to children through these elements were based on a set of behavioral objectives previously specified. Implementation of the program required the preparation of curriculum materials such as television scripts, video tape recordings, and the printed materials required for student use, parent use, teacher use, and use in the traveling classroom and home visitations.

During the time of the study reported here, the television broadcasts were over a commercial channel receivable on home sets. They were each one-half hour long and were broadcast five days a week for thirty-four weeks, which made a total of 170 broadcasts. The broadcasts presented an adult who was interested in children, who would take time to talk with them and do things with them which were of interest to the children. Broadcasting began on September 30, 1968, and concluded on May 23, 1969.

Home visitors were not trained teachers but were people who could readily establish rapport with both parents and children. Although the time varied from home to home and from visitor to visitor, the average visit was slightly over one-half hour in length. Visits were made weekly, with the first visit occurring during the week prior to September 30, 1968, and the last during the week ending May 23, 1969.

The traveling classroom was provided so that children might participate in group activities, experiences deemed necessary for proper development of social skills. Groups of ten to fifteen children came together once each week for approximately one and one-half hours, under the direction of a teacher and an aide. The traveling classroom was in operation only from February 3, 1969, until May 23, 1969.

The Sample

The target population for the study consisted of preschool children, ages three, four, and five, living in rural Appalachia. A group of children within the age range was selected from an area of southern West Virginia to receive the intervention. All

of them met four criteria: they lived within the viewing area of WOAY-TV, Channel 4, Oak Hill, West Virginia; they lived within a county whose local educational agency had agreed to participate in the study; their home was rural-farm or rural non-farm as defined by the United States Bureau of the Census; and their home was accessible from a public road. Additionally, Giles County, Virginia, outside the viewing area of WOAY-TV, was selected as the site for a control group. Children identified in Giles County met the same criteria as did those in the intervention group except for the first criterion, that of locality of residence.

The Hypotheses

Learning experiences may be provided to rural preschool children through a home-oriented program employing three elements: television broadcasts, home visits, and traveling classrooms. The curriculum for such a program may be based on a set of behavioral objectives appropriate to children of a given age level, and there may be included within this set of objectives certain ones dealing with quantitative skills, conservation, and problem solving--all of which are related to an understanding of mathematical concepts.

It was hypothesized that there would be differences displayed in the mathematical behavior of children receiving the home-oriented preschool program and of children not receiving such a program. It was expected that the combination of three elements would be more effective than the combination of television and home visits, and that either combination would be more effective than television alone. Further, it was predicted that this study would indicate a home-oriented program to be an effective approach to providing a preschool program to rural children.

The Data

For purposes of the total project, a group of approximately 450 children were identified. These were divided into three treatment groups of approximately 150 each. Each group was stratified by age and by sex.

For purposes of this study a smaller number from each of the three groups was identified, similarly stratified. This smaller number, along with the control group, was considered the sample.

The sample consisted of not less than four nor more than six children within each cell, with a cell defined by age (three, four, or five), sex (male or female), and treatment (T_1, T_2, T_3, T_4).

The four treatments were:

Treatment I (T_1) - Intervention through television broadcasts, home visits, and traveling classroom.

Treatment II (T_2) - Intervention through television broadcasts and home visits.

Treatment III (T_3) - Intervention through television broadcasts only.

Treatment IV (T_4) - No intervention.

Two test instruments were used to collect information for this study. The Peabody Picture Vocabulary Test was used as a measure of intelligence. It was administered both as a pretest and post-test. A curriculum specific test, the Appalachia Preschool Mathematics Test, was designed as a part of this study to test the cognitive skills in mathematics displayed by the children following the intervention. It was administered as a post-test only. A copy of the Appalachia Preschool Mathematics Test may be found in Appendix B of this report.

LIMITATIONS

This study was limited to a consideration of the children engaged in the Appalachia Preschool Education Program as designed and developed by the Appalachia Educational Laboratory, Inc. While it is thought the results might be generalized to all rural Appalachian preschool children, or indeed to rural children throughout the nation, such a generalization will not be made.

Mathematical concepts as expressed in a set of behavioral objectives in the cognitive area (listed in Appendix A) constitute a limiting factor. The great importance of other objectives in cognition, as well as all those in language, orienting and attending skills, and motor activities, was recognized. However, no attempt was made to assess the children's achievement in any area except mathematics.

The developmental effort of the Appalachia Preschool Education Program was planned for a three-year period (1968-1971), but this study has been limited to the first year (1968-1969). It is hoped that the work which has been done in this study has had some affect on the conduct of the second and third years of the program.

PLAN OF THE REPORT

Chapter I presents a statement of the problem and information pertaining to the need for and importance of the study. An outline of the procedures followed is given, and certain limitations on the study are noted.

Chapter II presents a selection of research reports and readings which are related to the various elements of the study. These include educational television for preschool children, the use of paraprofessional home visitors with preschool children, and the young child's cognitive abilities with particular reference to mathematics.

Chapter III presents the procedures used in the study. The three elements of intervention are described: television, home visits, and traveling classroom. The theoretical basis, the hypotheses, and the research design are presented. This is followed by a description of the sample--how it was identified and selected, and some of its characteristics. The test instruments used in the study are identified and described.

Chapter IV contains the analysis of the data. The results of each of the two tests used is given, along with the statistical analysis of those results. A final section contains the results of certain subtests of a curriculum specific mathematics test.

Chapter V contains a summary of the study, the conclusions reached on the basis of the results obtained, and recommendations for further investigations.

CHAPTER II

SURVEY OF THE LITERATURE

RELATED READINGS

Support for the problem attack developed for the Appalachia Early Childhood Program may readily be found in the literature.

Bloom, in his massive study of human characteristics, stated "It is evident that when the school and home environments are mutually reinforcing, learning is likely to be greatest."[1] Since he maintains that one-half of an individual's general intelligence at age eighteen has been developed by age four, and that the environment would have its greatest effect on any given characteristic during the period of its most rapid development, it would appear that the preschool years of a child are critical.

Although it would not appear possible to remove all disadvantaged preschool children to an environment more supportive than their own, it should be possible to extend their environment or add factors to it, thereby putting the school and home into the mutually reinforcing situation deemed necessary for learning. For the Appalachia program, a television broadcast and a home visitor have been introduced into the home environment, and a traveling classroom serves to extend it.

Bruner has stated in his theory of instruction that, "Any idea or problem or body of knowledge can be presented in a form simple enough so that any particular learner can understand it in a recognizable form."[2] The effectiveness of teaching mathematical

---

[1]Benjamin S. Bloom, op. cit., p. 128.

[2]Jerome S. Bruner, Toward a Theory of Instruction (Cambridge: Harvard University Press, 1968), p. 44.

concepts to preschool children by way of television, home visitors, and a traveling classroom was explored in this study. Bruner's theory was the guiding theory used in planning activities for the children.

Disadvantaged Preschool Children

There appeared to be a paucity of literature dealing with the rural child, particularly with the rural Appalachian preschool child. Of much greater concern to writers and researchers has been the urban disadvantaged child, and while the differences between rural and urban children are often striking, there are also similarities.

In a book of readings dealing with education for disadvantaged students, Goldberg stated that the lack of adequate male identification models in the home was a particular problem for boys and suggested the need for male teachers even in the very early years. Since broken homes often lead to significant differences in attitudes, self-concept, and achievement patterns for boys and girls, she suggested separate classes for boys and girls might prove desirable. However, data from Hooper and Marshall's study[3] and the current one indicate that rural families in West Virginia are largely intact.

Goldberg also recommended that:

> To compensate for the lack of "learning readiness" experiences characteristic of the preschool years of the disadvantaged pupil, the school should experiment with carefully designed programs beginning no later than age three which will provide the child with verbal and symbolic experiences

---

[3]Frank H. Hooper and William H. Marshall, The Initial Phase of a Preschool Curriculum Development Project, Final Report (Morgantown: West Virginia University, 1968), p. Q-13.

> which lay the foundation for later academic achievement and which the middle class preschool child so often has at home.[4]

The concern expressed by Goldberg for providing experiences which will lead more or less directly to improved achievement has recently become a concern of many others. Leeper wrote as follows:

> Flavell, an American exponent of Piaget, Ojemem and Pritchett, and Deutsch, among others, have presented evidence to show that cognitive development can be modified and/or accelerated by manipulating the child's environment in specific ways. As a result, many preschool programs are becoming more structured than in the past. Considered modifications of the more permissive, relatively unstructured, programs of the past, placing more emphasis on learning and intellectual development does result in better educational experiences for young children. It is only when undue stress is placed on learning, or on a single component of development, that the quality of good school programs is endangered.[5]

Speaking on the content of enrichment programs for early childhood, Deutsch and Deutsch noted that it was easy to assume that one should provide to disadvantaged children those experiences which they have lacked. It is this assumption which has caused many children to be taken on various trips--to the zoo, to a museum, to a library--and for teachers then to expect that development would be stimulated. Deutsch and Deutsch maintain that this assumption is false. Experiences missed at one age or developmental level cannot be retrieved at another. It is the function which can be retrieved, but it must be stimulated by experiences which are consistent with the child's development, cognitive organization, and knowledge at the later time, rather than

---

[4]Miriam L. Goldberg, "Factors affecting educational attainment in depressed urban areas," Education of the Disadvantaged, (eds.) A. Hary Passow, Miriam Goldberg, and A. J. Tannenbaum (New York: Holt, Rinehart and Winston, Inc., 1967), pp. 54-55.

[5]Sarah Hammond Leeper, et al., Good Schools for Young Children (New York: The MacMillan Co., 1968), p. 51.

the earlier. These authors stated the essentials for the intervention environment and curriculum as follows:

> The environment would demand development and stimulate it along certain parameters. It would include sensori-motor stimulation, opportunities for making perceptual discriminations, interacting with a verbally adequate adult, receiving some individual attention, linking words and objects and meaningfully relating them in stories or to varying experiential positive self-indentifications, being encouraged toward task perserverance, and being helped to receive both tangible and verbal rewards for relatively competent performance. Such an environment includes stimulation which would be demanding of responses consistent with achieved developmental capabilities, and which would have sufficient and continual feedback from adults.[6]

Educational Television

In searching for a delivery system to use to provide learning experiences for rural preschool children, the Appalachia Educational Laboratory early turned to the home television set. Others had also thought of this approach.

The report of the Carnegie Commission on Educational Television had recommended that various agencies sponsor extensive and innovative studies intended to develop better insights into the use of television in both formal and informal education. It was suggested that,

> In addition to universities, nonprofit corporations, and the stations themselves, some of the Regional Educational Laboratories contemplated in Title IV of the Elementary and Secondary Education Act of 1965 might be appropriate agencies to conduct the necessary programs of research and development.[7]

---

[6]Cynthia P. Deutsch and Martin Deutsch, "Brief reflections on the theory of early childhood programs," paper read before the Social Science Research Council Conference on Early Childhood Education, Chicago, Illinois, February 7, 8, and 9, 1966.

[7]Carnegie Corporation of New York, Public Television: A Program for Action, The report of the Carnegie Commission on Educational Television (New York: Bantam Books, Inc., 1967), p. 9.

Important as the Commission considered the educational potential of television to be for adults, the potential for children was considered even greater. It was felt that public television should give great attention to the needs of preschool children, particularly to interest and help those whose intellectual and cultural preparation might not otherwise be adequate. It was suggested that programs should help extend a child's power of observation and expression; should increase his "visual literacy" about the meaning of objects and processes; should heighten his natural curiosity; and should reveal to the child a world of visual reality, linking it to a comprehension of the abstract, the metaphorical, and the imaginary. "Programs to meet this responsibility will require art forms beyond that of most formal teaching, and will utilize adventure, surprise, suspense, and humor as their tools."[8]

One publication which sought to bring together the thinking on the use of television for preschool children was issued by the National Instructional Television Center. The major portion of the document attempts to identify, to explain, and to demonstrate desirable content and to present a production plan for television programs designed for young children. In it the author has tried to show the relationship between what the child is, what the learning goals for him should be, how the child goes about reaching these goals, and what the role of television should be in integrating these factors. However, as a final note of caution, it is pointed out that television has its limitations. It does not provide for tactile and manipulative experiences, and it does not provide for a two-way interaction. "The need for extensive and skillful interaction underscores the need for live, responsive adults in the child's environment."[9]

---

[8] Ibid., p. 95.

[9] Rose Mukerji, Television Guide Lines for Early Childhood Education (Bloomington, Indiana: National Instructional Television Center, 1969), p. 8.

Home Visitation

In an isolated, rural area the adult most common in the child's environment is the mother. While many writers urge parental involvement in the educational process, this involvement is often predicated on the mother's coming to the school for a conference, a film showing, a discussion on child health, or some other reason. Since this is often difficult or impossible for the rural mother, another approach seems to be indicated. Home visitation is one alternative.

Radin discussed a program conducted in the Ypsilanti Public Schools called the Supplementary Kindergarten Intervention Program (SKIP). Since it had been observed in several studies that the positive effects of preschool experience appeared to be washed out by the middle or end of first grade, SKIP was an attempt to stabilize pre-school gains. Children of low income families, but of high ability, who had participated in a compensatory preschool program were selected to participate.

> The hypothesis tested was that there were two components to a meaningful follow-up program for these youngsters. One component was a special class supplementing the regular kindergarten session and focusing on cognitive areas delimited by Piaget, such as classification, seriation, and representation. The second component was intense parent involvement in the educative process.[10]

Three groups were set up: Group III (Control) attended regular kindergarten class only. Group II was enrolled in a supplementary class (SKIP) which met four half days per week, when kindergarten was not in session. Group I also participated in the SKIP class and, in addition, mothers of the children received biweekly home visits from a counselor. The home counselor was a professional person.

---

[10]Norma Radin, "The impact of a kindergarten home counseling program," Exceptional Children, December, 1969, pp. 252.

Three instruments were used to measure change: The Stanford-Binet Intelligence Test; The Metropolitan Reading Readiness Test; and The Cognitive Home Environment Scale. Group I was superior on all measures.

"Most surprising was the finding that the significant experimental variable in the follow-up program was the home counseling component," Radin stated in her summary.[11]

Many programs, Head Start being a prime example, are turning to the use of paraprofessionals for classroom aides and for home visitors.

One group of aides was trained at the Early Childhood Education Laboratory of the College of Education of the University of Arizona. The group consisted of twelve women who had been employed as aides in a Child Development Center. The project was a part of a Migrant Opportunity Program, and all of the aides were migrants (Mexican, Negro, Indian, Anglo) and mothers. They ranged in age from twenty-four to fifty, and only one was a high school graduate. The training course lasted twelve weeks. Hobson describes it as follows:

> The training experience involved work with children from infancy through six. Arrangements were made for the trainees to observe the child for evidence of specific behaviors, for the variety of responses to people and to specific materials. Micro-teaching demonstrations with children from infancy through six were thoroughly critiqued to identify principles of learning, with the concomitant adult responsibility for systematized organization and methods for teaching. A variety of micro-teaching opportunities permitted the trainee, then, to apply this new knowledge with respect to the individual child and child groups. It was considered important that modeling should precede theorizing, thus giving reality to the theory. The theory was slowly but carefully refined from global awareness to increasingly discriminating concepts that could be grasped because they were not dependent upon verbalism and pedagese, being born from concrete experiential evidence.[12]

---

[11] Ibid., p. 254.

[12] Arline Hobson, Teachers and the Education of Aides (Urbana: National Laboratory on Early Childhood Education). Document No. 770706-A-Da-J-02, p. 37

Mathematics Curriculum

Several individuals and groups have given thought to types of research needed in the field of mathematics curriculum. Little if any attention has been given to pre-school needs; possibly, it is assumed that in the absence of a school there is no need for a curriculum.

Glennon, in a statement on the research needs in mathematics education for the elementary school, first gave an overview of past history. He indicated that prior to 1957 most research was concerned with the improvement of the teaching-learning process and was carried out by people whose orientation was educational psychology rather than curriculum theory. After 1957, there was a return to curriculum research led by mathematicians instead of psychologists, with their work organized around structure. Glennon saw evidence at the time of his statement, 1966, that leadership seemed to be returning to the psychologists with a concern for how best to teach mathematics. Excerpts from his key statement give as his opinion that: "Our greatest research need today. . .is for a theory of instruction with dimensions great enough to include our present theories of curriculum and theories of method.[13]

Glennon also expressed the opinion that while many researchers state it is impossible to separate "what we teach from how we teach," they attempt to do so. Curriculum innovators with little training in or sympathy for "methods," and methodizers who maintain the centrality of "process," have been equally unable to perceive the whole problem.[14]

---

[13]Vincent J. Glennon, "Research needs in elementary school mathematics education," The Arithmetic Teacher, May, 1966. p. 365.

[14]Ibid., p. 365.

A Conference on Needed Research in Mathematics Education was held at the University of Georgia in 1967. Among the papers read at the conference was one by Romberg and DeVault on the mathematics curriculum. They posed a research model which showed mathematical experiences as being affected by the mathematics program, the learner, the teacher, and the instruction, all of which operate in a social context. Research which effectively investigates the nature of learners' mathematics experiences must give appropriate consideration to a variety of aspects within each of the four elements listed. The above authors also point to the need for a major effort in theory building. They felt it necessary that there be interdisciplinary teams for mathematics curriculum research--teams which would include psychologists, classroom teachers, measurement specialists, mathematicians and mathematics educators; that there be more longitudinal and long-term studies; that there be more concern for the relevance of research hypotheses to current problems facing those responsible for building curricula for the schools; and that the research should be conducted in realistic educational settings.[15]

An exhaustive survey by Suydam of research on elementary school mathematics reports found 799 articles in American journals from 1900 to 1965. Of this number, 222 (over one-fourth) had been published in the 1961-1965 period. This serves to accent the emphasis being placed on this field today. In an analysis of the reports, it was found that pre-first-grade concepts were of prime concern in only nineteen studies, eighteen of which were surveys and only one was experimental. There were ten reports on readiness--five survey, one descriptive, two correlational, and two

---

[15]Thomas A. Romberg and M. DeVault, "Mathematics curriculum: needed research," Journal of Research and Development in Education, Vol. 1, No. 1, pp. 95-110.

experimental. This survey of research was supported by the United States Office of Education as one attempt to assess the direction and validity of such research. The conclusion was reached that more consideration needs to be made of the points on which more knowledge is needed, since the studies seemed almost randomly distributed among topics. It was also concluded that more careful and precise planning should be done, since few studies were found to be completely valid.[16] These conclusions would seem to bear out the contentions of the Glennon and the Romberg and DeVault references.

The need for a basic consideration of the child, as well as the mathematics, has been the concern of several authors. Westcott and Smith said, "In order to establish valid objectives for teaching mathematics, the teacher has to begin with some basic assumptions about children, about mathematics, and about creativity."[17] The above authors saw the child as an active, stimulus-seeking organism and rejected the notion that the normal child was fundamentally passive.

In a paper entitled "Psychological issues in the development of mathematics curricula for socially disadvantaged children," Beilin and Gotkin pointed out that performance differences in the early grades are in those skills which enable a child to process formal information provided in the school curriculum and in informal information provided by out-of-school experiences. The environment of the slum child has placed severe constraints, both physical and social, upon certain factors of his development but not upon all. (This appears to be true of other disadvantaged groups as well,

---

[16]Marilyn N. Suydam, "The status of research on elementary school mathematics," The Arithmetic Teacher, December, 1967. pp. 684-689.

[17]Alvin M. Westcott and James A. Smith, Creative Teaching of Mathematics in the Elementary School (Boston: Allyn and Bacon, Inc., 1967), p. 11.

i.e., rural Appalachian children.)[18] Among the suggestions for overcoming the disadvantages listed, Beilin and Gotkin said:

> Since so many of the problems of learning with the socially disadvantaged start at an early age, it would be desirable to initiate programs related to mathematics instruction at the earliest school age possible, even in the kindergarten and nursery school. In preschool classes, pre-mathematics programs should emphasize perceptual training and concept development relative to space, number, time, and related conceptual domains since these later become the basis of conceptual systems symbolically represented. The development of curricula should proceed from the early grades upward.[19]

RELATED RESEARCH

A major shift in emphasis in early childhood education research has occurred within the past decade. Much of the literature prior to 1960 had been focused on the methods, materials, equipment, situations, and environment that are required to effect the emotional, social, and personal adjustment of young children, particularly as related to nursery schools and kindergartens. Sears and Dowley have stated, "It is curious that in the stated aims and purposes of the nursery school, intellectual development of the child has been very little considered. The review of objectives cited in the literature hardly refers to these cognitive aspects of a child's development."[20]

In an analysis of more recent research in childhood education, Scott, Eklund, and Miller saw a much different picture.

---

[18]Hooper and Marshall, op. cit., p. 95.

[19]Harry Beilin and Lassar G. Gotkin, "Psychological issues in the development of mathematics curricula for socially disadvantaged children," Education of the Disadvantaged, op. cit., p. 297.

[20]Paline S. Sears and Edith M. Dowley, "Research on Teaching in the Nursery School," Handbook of Research on Teaching, (ed.) N. L. Gage (Chicago: Rand McNally and Company, 1963), p. 848.

> Almost all of the curriculum components under development had a heavy cognitive emphasis. The theories of Piaget, Bruner and others have strongly affected the development of teaching materials and procedures in this country today. This major emphasis on cognitively oriented curriculum stems quite possibly from the Sputnik era and the push for academic excellence in America in our technologic race with Russia. In addition, much of the basic research under way had a strong cognitive orientation.[21]

Many of the studies conducted during the decade of the sixties related to the current study on one or more dimensions without being congruent. The particular assemblage of elements operating in a home-oriented setting appears to be unique.

Brazziel and Terrell in 1962 reported an experiment with some similarities. It was an experiment designed to develop readiness in a group of culturally disadvantaged first-grade children. The population consisted of Negro first-grade children from predominantly farm families. There were twenty-six in the experimental group and twenty-five, twenty-one, and twenty in three control groups. Elements of the intervention were a six-week classroom readiness program, weekly parents' meetings, and thirty minutes of educational television in the home. The training focus was described as a guidance-oriented, intensive parent-teacher approach to the formation of reading and number readiness. The Metropolitan Readiness Test was used as an assessment index. Following the intervention, the experimental group scored at the fiftieth percentile (national average) while the control groups scored at the sixteenth, fourteenth, and thirteenth percentiles.[22]

---

[21] Myrtle Scott, Susan J. Eklund, and James O. Miller, An Analysis of Early Childhood Education Research and Development (Urbana: National Laboratory on Early Childhood Education, 1969), p. 11.

[22] W. F. Brazziel and Mary Ferrell, "An experiment in the development of readiness in a culturally disadvantaged group of first grade children," Journal of Negro Education, 1962, Vol. 31, pp. 4-7.

Home Visitation

A continuing series of studies dating back to 1961 has been carried on by Dr. Susan Gray and others at the Demonstration and Research Center for Early Education (DARCEE) at George Peabody College for Teachers. Children from low income families have been of particular concern. These studies emphasize the mother as the chief source of stimulation in the early years for the child within the family setting. She imposes the necessary order and structure upon the environment for the child's development of competence and control. She also plays the key role in sustaining developing skills and in motivating the child to develop more complex abilities during the early years. Because of this emphasis on the mother, the DARCEE group has explored in depth the use of paraprofessionals who work in the home with the mother and child.

The basic design in the DARCEE studies provided for three groups receiving differing treatments, plus a fourth group receiving no intervention. Group I provided for the mother and child to be brought to the center for a training program each week. In Group II, the child of the family was the only member of the family enrolled in a program. For Group III, the home was visited once each week, but the family had no direct contact with the early training center. The Control Group was chosen to match demographic, structural, and environmental characteristics of the treatment families but received no planned intervention other than testing.[23]

One study which grew out of this overall design dealt with a group of urban Negro children, whose parents had an educational level no higher than the eighth

---

[23]Rupert A. Klaus and Susan W. Gray, Early Training Project for Disadvantaged Children: A Report After Five Years (Nashville, Tennessee: George Peabody College for Teachers, 1967).

grade, where the family income was below $3,000, and where the head of the family was in an unskilled or semiskilled occupation or unemployed. The median number of children per family was five, and half of the homes had no father present. In this study, Group T_1 had three ten-week summer school sessions, plus a weekly visitor for the rest of the year. Group T_2 had two ten-week summer school sessions, plus the weekly visitor for the remainder of the year. Groups T_3 and T_4 were both for control purposes: Group T_3, from the same community as Groups T_1 and T_2, and Group T_4 from another similar area. These received no substantive intervention. The experimental groups were involved in actual classroom experiences where the curriculum was designed to prevent the accumulation of deficits commonly supposed to occur in the development of disadvantaged children. The intention was to give the children a more positive attitude toward school-type achievement and, indeed, toward achievement in general. The materials used in the classrooms were intended to improve those abilities and aptitudes which a child must have to succeed when he enters the public school. In addition to the classroom experiences, each home was visited once a week, at which time the child and his family received additional attention. The child was provided school-type materials to be worked on at home. An attempt was made to involve the entire family in order to foster achievement as well as to improve attitudes. Several generally accepted intelligence tests were used as assessment instruments. During the period of time the study continued, the two experimental groups gained an average of seven IQ points while the two control groups lost an average of five IQ points. This difference is statistically significant. It was pointed out that even though the experimental groups did not record a large gain numerically, without intervention they would

have been expected to have lost ground (as the control groups did) even before they had entered school.[24]

Educational Television

Under the auspices of the National Instructional Television Center, Bloomington, Indiana, a group of nationally known early childhood and instructional television specialists assembled in 1967 to review early childhood programing. Thirty television programs designed for both in-school and out-of-school audiences were viewed. Enough of each program was viewed to permit adequate discussion and to provide for valid judgments; the programs were examined in light of the best current thinking and practice in early childhood education and in instructional television. The panel of specialists was ". . .astounded. . .appalled. . .upset with the prospects of early childhood education if this (the programs they viewed) is allowed to continue."[25]

A panel of experts giving a collective judgment may not be considered research, but the results of these deliberations constitute perhaps the best assessment of television for early childhood available today. Little formal research on the effectiveness of television for preschool children has been done.

A study, which might be considered representative of the research which has been done, was conducted in relation to the series Preparing Your Child for Reading, produced and telecast by the educational television station KRMA-TV, Denver, Colorado. The series was a cooperative effort between the Denver Public Schools and the Carnegie

---

[24]Susan W. Gray and A. Klaus, "An experimental preschool program for culturally deprived children," Child Development, September, 1967, pp. 819-826.

[25]Mukerji, op. cit., p. 8.

Corporation. It was proposed that techniques of teaching beginning reading be introduced to parents of young children via instructional television and parent manuals.

Specific objectives listed were to:

1. demonstrate sound, organized methods of teaching reading to parents;
2. assist parents to see correct ways of working with their children. . .;
3. serve as a means of stimulating and motivating parents in their initial and continuing efforts;
4. provide a "pacing" or more orderly progression than would otherwise be available.[26]

Parents and their children were divided into three treatment groups, as follows:

Group X. Parents received no instruction in teaching the basic reading skills. However, the children took the same tests as those in the other groups.

Group Y. Parents were provided instruction for teaching the basic reading skills through the use of a guidebook and via educational television lessons.

Group Z. The parents were provided instruction for teaching basic reading skills by means of the guidebook and the 16 mm films of the television lessons in group sessions on alternate weeks, led by experienced teachers.[27]

Instructional programs continued for a total of sixteen weeks, progressing at a rate suitable for adults. Children were not expected to proceed at the same rate but according to individual ability and interest. Assessment instruments used with all children in the study included the Stanford-Binet Intelligence Test and tests three and five of the Houghton Mifflin Test of Skills Basic to Beginning Reading. Questionnaires were

---

[26]Joseph E. Brzeinski, "Preparing for reading with TV," Educational Media (TV) for the Preschool Child,(ed.) Lester F. Beck (Monmouth: Oregon State System of Higher Education, 1965), p. 1-5.

[27]Ibid., p. 1-14.

administered to all parents. The conclusion was reached that educational television was effective for instructing parents in preparing their children for reading. Also, television instruction was as effective as that provided by experienced teachers using 16 mm films with small discussion groups. Further, parents could teach certain basic skills of beginning reading to their preschool children provided the children are four and one-half years of age or older; the children receive practice for a minimum of thirty minutes per week; and they are read to for a minimum of sixty minutes per week.[28]

Preschool Mathematics

The dearth of research related to preschool children and mathematics was mentioned earlier. The following studies might be considered representative of the body of literature available.

Montague used four kindergarten classes to explore the effect of difference in socioeconomic background on the arithmetic concepts of kindergarten children. The study compared fifty-one low socioeconomic children with thirty-one high socioeconomic children. The two teachers involved were considered comparable, based on age, experience, education, and ability as judged by their principals. The test instrument used was The Arithmetic Concepts Inventory for Kindergarten and Entering First Grade, by Ruddell, which has a reliability coefficient of .89. No attempt was made to assess the intelligence of the children, and there was no significant difference in the chronological ages. It was found that there was a difference at the .01 level of significance between total groups, between boys, and between girls, in each case in favor of the high socioeconomic children. The findings indicated a relationship between arithmetic

---

[28] Ibid., p. 1-16.

concepts held by kindergartners and socioeconomic areas from which the children came.[29]

Williams conducted a study to assess the mathematical concepts, skills, and abilities of children as they first enter kindergarten. Its subjects were 595 children from the greater metropolitan area of Los Angeles. Williams stated that the purposes of his study were:

> (1) to ascertain the nature and extent of achievement of pupils who are entering kindergarten with respect to selected mathematical concepts, skills, and abilities as described by test items requiring mathematical insights and/or skills and abilities;
>
> (2) to discover the levels of achievement of various groups when categorized by selected psychological and sociological factors;
>
> (3) to ascertain by the correlation method the extent of relationship that exists between the test of mathematical achievement and various psychological and sociological factors; and
>
> (4) to discover some of the circumstances and conditions existing in the home which apparently influence some kindergarten entrants to attain a high level of mathematical achievement while others of equal mental ability fail to realize proportionate accomplishment.[30]

The test used to describe the mathematical achievement was devised specifically for the above study, with the concepts, skills, and abilities to be tested categorized according to the Strands Report of the Advisory Committee on Mathematics for the State of California. It had a reliability coefficient (Kuder - Richardson Formula 21) of .90 in this investigation. In addition, the Science Research Associates Primary

---

[29]David O. Montague, "Arithmetic concepts of kindergarten children in contrasting socio-economic areas," The Elementary School Journal, April, 1964, pp. 393-396.

[30]Alfred H. Williams, "Mathematical concepts, skills, and abilities of kindergarten entrants," The Arithmetic Teacher, April, 1965, p. 261.

Mental Abilities Test and a parent questionnaire form were used. Data were collected prior to the end of the fourth week of kindergarten. A detailed analysis of the data was made. Some of the conclusions reached that appear particularly significant were:

1. The substantial number of mathematical concepts, skills, and abilities possessed by kindergarten entrants indicate that mathematics is a part of the preschool child's experience.

2. It would appear that appropriate mathematical instruction based upon the child's experience would be beneficial and profitable to the kindergarten pupil in terms of satisfying his immediate and future needs.

3. When so many kindergarten entrants can respond successfully to questions concerning the mathematical strands of measurement, number, geometry, and logic, it would seem that these topics should be used in the beginning as a basis for extending the mathematical concepts, skills, and abilities of children.

8. Since such mental factors as verbal meaning, perceptual ability, and spatial ability are substantially related to mathematical achievement, activities designed to develop these abilities could be incorporated advantageously into the kindergarten course of study.[31]

Piaget-Related Studies

The influence of Piaget on the literature is becoming increasingly obvious, with some studies being made as replications of those of Piaget, and other studies using his work as a starting point for further investigation.

Elkind has been particularly active in replication studies, trying to determine whether the stages of development identified by Piaget from illustrative experimental examples could also be identified by using standardized procedures and a statistical

---

[31] Ibid., p. 267.

design. In one such study, Elkind used ninety children in three groups of thirty each at three age levels (medians four years, six months; five years, seven months; and six years, nine months). They were heterogeneous with respect to socioeconomic background and intelligence. Three sets of materials, called blocks, slats, and sticks, were used as materials. Tests were administered in size discrimination, seriation, and numeration with each set of materials. The experimental design involved three independent variables: age, materials, and tests. The .01 level of significance was used as the criterion for rejecting the null hypothesis. Piaget's observations were confirmed. It was shown that performance increased with age; that discrimination items were the least difficult; that seriation items were of intermediate difficulty, and that numeration items were the most difficult; and the more perceptible the differences in the materials used, the more easily they were mastered.[32]

One of the fundamental assumptions of Piaget's theory of cognitive growth is that there is a fixed order in which concepts are acquired which is determined by the child's increasing ability to use complex logical operations. Eleven steps were identified for the mastery of classification. Kofsky translated these steps into eleven experimental tasks in order to test two aspects of Piaget's theory: ". . .(a) that the order of difficulty of these tasks corresponds to the developmental sequence described by Piaget, and (b) Ss who have acquired a particular rule have also mastered all the simpler prerequisite rules."[33] Kofsky's sample consisted of 122 children divided nearly

---

[32]David Elkin, "Discrimination, seriation, and numeration of size and dimensional differences in young children: Piaget replication study VI," Logical Thinking in Children, (eds.) Irving E. Sigel and Frank H. Hooper (New York: Holt, Rinehart and Winston, Inc., 1968), pp. 56-75.

[33]Ellin Kofsky, "A scalagram study of classificatory development," Logical Thinking in Children, (eds.) Irving E. Sigel and Frank H. Hooper (New York: Holt, Rinehart and Winston, Inc., 1968), p. 212.

equally among six age groups of four to nine years, and between boys and girls within groups. A very detailed analysis of the data gave a mixed picture of confirmed and denied hypotheses. There was a definite correlation of age with score, and the age continuum appeared to be divisible into three segments: the nine-year-olds, the seven- and eight-year-olds, and the four-, five-, six-year-olds. There appeared to be six different levels of difficulty in the tasks. According to Kofsky,

> The steps are: (a) the ability to match objects which share common features, both of which appeared well within the grasp of all children tested; (b) understanding "some and all" relationships and proficiency in forming exhaustive classes (EC), which occurred in a majority of the 5-year-olds; (c) a grasp of the elementary relations among objects and classes in a hierarchy including the knowledge that an object can belong to more than one class (MM) and that the total number of objects in the subclasses is equal to the extension of the superordinate class ($A + A^1$), which was demonstrated by most of the 6-year-olds; (d) conservation of hierarchy ($B - A^1$), conservation (CON), and reclassification (HR), which were performed successfully by most of the 7-year-olds; (e) knowledge of inclusion which was apparent in most of the 9-year-olds; and (f) hierarchial classification, which was mastered by less than half of the oldest group.[34]

The data seemed to indicate that, contrary to Piaget's prediction of an invariant order in which children learn these tasks, there is at best a partial order. Kofsky concluded that individuals vary in the sequence of mastery of cognitive tasks and in the steps by which they master a particular cognitive task.

Appalachia Preschool Survey

Most of the research described to this point has been conducted with urban children, Negro children, nursery school or kindergarten children--but not with the Appalachian preschool children. During the initial planning for the Appalachia Preschool Education Project, the Division of Family Resources of the College of Human

---

[34] Ibid., p. 218.

Resources and Education, West Virginia University, was commissioned to conduct a survey of the literature. It was found that very little was available which had a direct bearing on the target population. As step two of the planning process, the same organization conducted an in-depth study of the characteristics of the Appalachian child of three, four, five, and six years of age.

The assessment was conducted with 160 children drawn equally from Monongalia and Upshur Counties of West Virginia, divided equally between boys and girls, and with equal numbers of three and one-half, four and one-half, five and one-half, and six and one-half year old children. An interview-questionnaire was used to assess general ecological conditions of the children's environment, parents' academic aspirations for their children, and a series of child rearing scales and inventories. The intellectual assessment was divided into two parts with equal numbers of children being administered Battery A and Battery B. Battery A consisted of the Peabody Picture Vocabulary Test, the Stanford-Binet Intelligence Test, Kagan's Matching From Familiar Figures Cognitive Style Task, and Kagan's Draw-A-Line Motor Inhibition Task. Battery B consisted of the Peabody Picture Vocabulary Test, the Illinois Test of Psycholinguistic Abilities, the Frostig Developmental Test of Visual Perception, and a verbal doll play session. Additionally, the five and one-half and six and one-half year old children in both groups received a series of Piagetian tasks designed to assess conservation, seriation, serial correspondence, and classification skills.

Generally, this sample might be characterized as upper-lower, lower-middle class; rural farm, rural non-farm, or small town; intact married families; 86 per cent Caucasian and 14 per cent Negrop non-mobile; with family income below $2,000 for approximately 31 per cent of the families. On the intellectual assessment, IQ scores

derived from the Peabody Picture Vocabulary Test were below the national average, but from the Stanford-Binet Intelligence Test, they were within the 90-100 normality range. On the latter measure, it was noticed that the children were more likely to succeed on performance items than on verbal items. On the Frostig test there appeared to be weaknesses on those subtests relevant to reading-readiness skills. Scores on the Illinois Test of Psycholinguistic Abilities indicated increased decrements as the children grew older, but decoding performance was superior to encoding ability. Performance on Piagetian tasks was quite adequate, with boys superior to girls.

> These results seem to show. . .a picture of cultural diversity rather than uniform cognitive-intellectual deficits. . . [These] deficits tend to center upon verbal tasks or those problem settings which demand symbolic representation. . . It seems imperative that future research directed toward the children of this region [Appalachia] which deals with additional comparative behavioral norms or with remedial intervention programs should carefully specify the particular psychological abilities and capacities in question.[35]

SUMMARY

In Chapter II an attempt has been made to bring together examples of research reports and readings which have a direct relationship to this study.

Each section of the chapter has one or more references to the use of educational television with preschool children, the use of paraprofessionals with preschool children, and the teaching of mathematical concepts to preschool children, including Piaget-related studies.

There did not appear to be any research in the literature which related to the use of a traveling classroom such as the one employed in the Appalachia Preschool Education Program.

---

[35] Hooper and Marshall, op. cit., p. 96.

Conceptualization and implementation of the program drew heavily upon various studies reported in this chapter. Of particular note were the studies of Elkind and Kofsky, which were consulted while planning the curriculum specific mathematics test. The National Instructional Television Center publication on television for preschool children had an effect on the development of the television element of the program. Invaluable background material was found in the Hooper and Marshall study of rural Appalachian children.

CHAPTER III

PROCEDURE

The Appalachia Preschool Education Program calls for three intervention elements to be provided to rural Appalachian children in or near their homes. To test the feasibility of this program, a group of three-, four-, and five-year-old children in a rural area of West Virginia were selected to participate in a three-year field study. Various test instruments were selected or constructed for gathering data. In the following discussion the intervention, the sample, and the test instruments will each be treated separately.

THE INTERVENTION

Curriculum Materials Team

On July 1, 1968, a curriculum materials team of five members was charged with the task of relating data describing the characteristics of Appalachian preschool children to a group of behavioral objectives for preschool children and, from this information, to synthesize an instructional program relevant to rural Appalachian children. It was necessary that activities appropriate to the television, home visitor, and traveling classroom elements of the program be developed; that procedures to provide feedback from children in the sample to the team be designed; and that all of the curriculum materials required to implement the program be produced. Curriculum materials included: television scripts; video tape recordings of these scripts; written materials required for student use, parent use, and teacher use; materials for use in the traveling classroom; and materials for the home visitations.

Approximately the first month of production was based entirely on the team's judgment on content and presentation. Once the program was in operation, feedback from children in the sample became an important input to planning sessions.

The team operated out of the WSAZ-TV studio in Charleston, West Virginia. Office space was provided at all times. Studio space, technical crew, and equipment were provided for two hours per day, five days per week, at a regularly scheduled time.

Television Broadcasts

The television element of the program was called "Around the Bend." The broadcasts presented an adult, Patty, interested in children, who would take time to talk with them and do things with them that were of interest to children. A one-to-one relationship was presented, with Patty talking directly to the child at home. Many opportunities for response and involvement on the part of the child were provided.

In keeping with the home orientation of the preschool program, the basic set represented Patty's home. The kitchen, the living room, and the front yard were each used as work areas for those activities considered appropriate. Field trips were provided through the use of film. This gave an opportunity to get out of the set and to expand the child's experience by showing him places not otherwise accessible to him. In general, the television guidelines for early childhood education as established by the National Instructional Television Center were followed.[1]

Some specific activities related to the teaching of mathematical concepts follow:

---

[1]Mukerji, op. cit., pp. 17-27.

1. A mother rabbit and a baby rabbit were shown in the yard. Patty discussed large and small, using the two rabbits as examples--large ears, small ears; large feet, small feet; large rabbit, small rabbit.

2. Patty displayed a number of objects which formed a set. She then displayed several numerals, gave the child an opportunity to matc' set with the correct numeral, and then provided the correct response.

3. A trip to a fire station was used as an opportunity to teach time sequence of events.

4. Patty and the childrer sang counting songs together (Ten Little Indians) in the living room.

5. Animation was used to show embedded plane figures in a picture. A picture was shown which incorporated squares, triangles, and circles. After the child was given an opportunity to locate the figures called for, the figures were outlined so they were easily seen.

There were 141 video tapes produced for the 1968-1969 school year, each of which ran for twenty-eight minutes. There were 169 broadcasts, twenty-eight of which were repeats. Programs were broadcast from nine to nine-thirty, five mornings a week, beginning on September 30, 1968, and ending on May 23, 1969. They were carried by a commercial station, WOAY-TV, Oak Hill, West Virginia, and could be received on home television sets.

Of the 141 video tapes produced, 71 presented mathematical topics while 70 did not. Of the 169 broadcasts, 84 were concerned with mathematics and 85 were not. Not all broadcasts were equally concerned with mathematics. A four-category system based on the amount of time devoted to mathematical concepts was used to classify the broadcasts. Those broadcasts, which devoted fourteen minutes or more to mathematics, were classified as primarily mathematical; seven to fourteen minutes, strongly

mathematical; four to seven minutes, somewhat mathematical; and less than four minutes, not mathematical. Table 1 presents data based on this classification.

TABLE 1

MATHEMATICAL CONTENT OF "AROUND THE BEND"
TELEVISION VIDEO TAPES AND BROADCASTS

Classification	Video Tapes	Broadcasts
Primarily Mathematical	25	29
Strongly Mathematical	22	26
Somewhat Mathematical	24	29
Not Mathematical	70	85
Totals	141	169

Appendix C presents a list of the working titles of the video tapes concerned with mathematics, a concise statement of the mathematical objectives for each one, and an indication of the amount of time allotted to mathematics instruction on each video tape.

Home Visits

Eight home visitors were employed from the area within which the children of the sample were drawn. The first step in the selection process was a request for referrals from the State Employment Service. Requirements were set as (1) a high school graduate or equivalent, (2) twenty years of age or older, and (3) holds a driver's license and has a car available. A personal interview with two Appalachia Educational Laboratory staff members was the final step in the employment procedure.

The eight women selected ranged from twenty to over sixty years in age; in education from General Educational Development certificate to two years of college; and in work experience from no previous work experience to Head Start teacher's aide and substitute teacher. The home visitors, although not professionally trained teachers, were people who could readily establish rapport with both parents and children in the area in which they were to work.

The home visitors attended a three-week training course in which the emphasis was on child development, learning activities of young children, and sensitivity training. During early September the home visitors surveyed certain areas to identify prospective enrollees for the preschool program. When the sample population was selected, they returned to the homes of the selected children and did a portion of the pretesting. Thus, the first personal contact with the project came to the homes via the home visitor, and this contact was maintained through them in their weekly home visits.

The first visit for program purposes came during the week prior to September 30, 1968, and the visits continued through the week of May 23, 1969. Although the time varied from home to home and from visitor to visitor, the average visit was slightly more than one-half hour in length.

During each visit, the home visitor was expected to explain the content of the coming week's lessons; provide any materials required which could not ordinarily be found in the home, including work sheets which had been prepared by the curriculum materials team; describe and talk about things which could be found at home, such as buttons or acorns for counters; describe appropriate activities for parent and child to do together which would further the objectives for the week; gather feedback on

program interest and effectiveness for the preceding week; and counsel with the parent and child on the importance of educational activities at all ages.

Among the activities for the child in his home was one which made use of the old story, "Goldilocks and the Three Bears." The home visitor delivered to the mother several sheets of paper on which were printed pictures of the characters and objects mentioned in the story. These were to be cut out and given to the child just prior to the television broadcast on a given morning. That day Patty told the story, using similar cutouts, encouraging the child to manipulate his cutouts and tell the story along with her. Patty emphasized the concepts, large, larger, largest, small, smaller, smallest. She also stressed sequence of events. The mother was asked to listen to the child tell the story several more times during the following days, helping the child with the terms Patty had used and with the sequence of events.

There were worksheets of several types. Some provided sets of objects to be matched with numerals, some were designed for seriation exercises, and some were classification activities. A popular game, based on the move by spinner races, had the spinner and the path marked off with geometric shapes rather than with numbers. A player could move his marker to the next space which had the geometric shape indicated by his flip of the spinner.

Traveling Classroom

It was deemed necessary that the child receive a group experience in order to provide for the proper development of social skills. To alleviate the long trips which would be required to bring groups of children to a central location, it was proposed

that a traveling classroom be provided which would travel a weekly circuit, meeting the children in groups of ten to fifteen.

A unit was designed to meet the specific needs of preschool children. Procurement procedures were started in May of 1968, but due to difficulties in securing United States Office of Education approval and funding, the unit did not go into service until February 3, 1969. Delivery of the unit marked the start of the full three-element program.

The traveling classroom was essentially a classroom on a truck. The truck was a standard International CO 1600, four-speed transmission, with power brakes and steering. The body was 22 feet long and 8 feet wide. It was completely equipped--with an audiovisual center, a listening center, a sound responsive light organ, a cooking center, and a toilet. It was furnished with wall-to-wall carpet and child-size furniture and cabinets. It was colorfully painted, well lighted, and comfortably heated and cooled--an attractive environment for young children.

A teacher and a teacher's aide staffed the unit, serving both as instructors and as drivers. The teacher was a professional, with a master's degree and seventeen years of teaching experience. The aide was selected and trained by the same methods as the home visitors.

Each child was scheduled to visit the traveling classroom once a week for one and one-half hours. Parents had the responsibility of getting the children to the location at the scheduled time. When the child arrived, various individual activities were available to him to choose from as he pleased. As the group assembled, the children moved from individual activities into larger group activities. A snack was served

during each session as a change of pace, as a whole group activity, and as a social learning situation.

Mathematical activities consisted of such experiences as working with a balance beam, doing seriation and classification type puzzles, matching sets and numerals in a game format, other mathematical matching games, and numerous question-and-response situations with the teacher or the aide. Many activities of the better nursery schools and kindergartens were duplicated in the traveling classroom. The objectives and activities were directly correlated with those of the television broadcasts and the home visitors.

THEORY, HYPOTHESES, AND RESEARCH DESIGN

It was theorized that learning experiences might be provided to rural preschool children through a home-oriented program employing three elements: television broadcasts, home visits, and traveling classrooms. The curriculum for such a program might be based on a set of behavioral objectives appropriate to children of a given age level, and there might be included within this set of objectives certain ones dealing with quantitative skills, seriation tasks, classification, conservation, and problem solving, all of which are related to an understanding of mathematical concepts.

It was hypothesized that there would be differences displayed in the mathematical behaviors of children receiving the home-oriented preschool program as compared to the mathematical behaviors of children not receiving such a program. It was expected that the combination of the three elements would be shown to be more effective than the combination of television and home visits, and that either combination would

be more effective than television alone. Further, it was predicted that there would be evidence that a home-oriented program would be an effective approach to providing a preschool program to rural children.

To test the hypotheses a research design of four treatments was drawn up. The treatments were:

Treatment I (T_1) - Intervention through a daily television broadcast, a weekly visit by a paraprofessional and a weekly visit to a traveling classroom.

Treatment II (T_2) - Intervention through a daily television broadcast and a weekly visit by a paraprofessional.

Treatment III (T_3) - Intervention through a daily television broadcast.

Treatment IV (T_4) - No intervention.

The variables of age and sex were controlled so that there would be nearly equal numbers of boys and girls and nearly equal numbers of three-, four-, and five-year-old children. Ages were computed as of the birthday preceding November 1, 1968.

The sample consisted of not fewer than four children within each cell, with a cell defined by age (three, four, or five), sex (male or female), and treatment (T_1, T_2, T_3, or T_4).

Nine hypotheses in the null form were written against which to test the children's performance. An .05 level of significance was established as the criterion for rejecting the null hypothesis. The hypotheses were:

1. There are no differences between treatment groups as measured by the Peabody Picture Vocabulary Test at the beginning of the intervention period.

2. There are no differences between treatment groups as measured by the Peabody Picture Vocabulary Test at the end of the intervention period.

3. There are no differences between treatment groups as measured by gain scores on the Peabody Picture Vocabulary Test.

4. There are no differences between boys and girls as measured by the Peabody Picture Vocabulary Test.

5. There are no differences between treatment groups as measured by Part I of the Appalachia Preschool Mathematics Test.

6. There are no differences between treatment groups as measured by Part II of the Appalachia Preschool Mathematics Test.

7. There are no differences between treatment groups as measured by the complete Appalachia Preschool Mathematics Test.

8. There are no differences between boys and girls as measured by the Appalachia Preschool Mathematics Test.

9. There are no differences between three-, four-, and five-year-old children as measured by the Appalachia Preschool Mathematics Test.

THE SAMPLE

Identification and Selection

During the planning stages of the program various news releases had gone out to educational leaders in the region served by the Appalachia Educational Laboratory. A group of school superintendents interested in providing better services for the children of their area requested that the field test be carried on within their counties. After a series of meetings between the superintendents and Laboratory personnel and an examination of the area to determine the degree to which it was typical of West Virginia, it was decided to respond affirmatively to their request. A cooperative agreement between the counties of Fayette, Mercer, Monroe, McDowell, Nicholas, Raleigh, Summers, and Wyoming and the Laboratory was signed. All of these counties are within the viewing area of WOAY-TV, Oak Hill, West Virginia.

Because the nature of two elements of the intervention required extensive travel, it was necessary to restrict the area to be covered by the program. Coverage was thus restricted to all of Mercer, Raleigh, and Summers Counties and to that portion of Fayette County south of Oak Hill, West Virginia. It was also necessary to work with clusters of children, so a cluster sampling technique was used.[2]

Large scale maps of the area, prepared by the West Virginia State Road Commission, were secured. These maps were marked in grids approximately four miles east and west and five miles north and south. All grids containing incorporated cities or towns were eliminated from consideration, as were grids containing no public road (state and national parks occupy a portion of the area). The remaining grids were numbered consecutively from one to forty-one. Fifteen grids were randomly selected, and five each were randomly assigned to three treatment groups, T_1, T_2, and T_3. On September 2, 1968, surveys were initiated to identify the preschool children of the appropriate ages within each of the fifteen grids. During the survey, less than five per cent of the parents with children eligible to participate declined to do so.

In one of the grids a kindergarten program financed by a special grant was found to be in operation. This grid was discarded in favor of one adjacent to it but outside the attendance area of the kindergarten.

Almost 750 prospective enrollees were located. After these children were listed by age, sex, and treatment, a random sample was drawn for participation in the program. There were twenty-five children in each cell, making a total of 150 in a treatment group.

---

[2]W. Allen Wallis and Harry V. Roberts, Statistics: A New Approach (Brooklyn: The Free Press, Inc., 1956), p. 489.

Because of the extensive testing planned, a smaller sample was randomly selected from each group of twenty-five. A minimum of four in each small sample cell was considered necessary, so six were selected to allow for sample attrition.

Giles County, Virginia, was selected as a site for the control area. It was outside the viewing area of WOAY-TV and did not have kindergarten classes in its rural sections. From a school census report a random sample of twenty-six subjects, stratified to three age levels and two sex levels, was drawn for the control (T_4) group.

Full information was collected on 121 subjects. Table II provides further information on the distribution of subjects in the small sample.

TABLE II

THE SAMPLE BY AGE, SEX, AND TREATMENT

Elements		Age 3		Age 4		Age 5		Total
		Boys	Girls	Boys	Girls	Boys	Girls	
T_1	TV; HV; TC	6	6	6	4	6	6	34
T_2	TV; HV	4	6	4	5	5	5	29
T_3	TV	6	6	5	5	6	4	32
T_4	None	4	4	4	5	5	4	26
	N=121	20	22	19	19	22	19	

Characteristics

Some general socioeconomic information was collected by means of a family questionnaire. This information served somewhat to describe the circumstances under which the children lived. A complete summary will be found in Appendix D.

In general, the children of the sample came from intact married families, predominantely white, with the father working and the mother at home. Place of residence was primarily rural non-farm as defined by the Census Bureau. Almost 75 per cent of the families owned their own homes; none lived in an apartment. Nearly 70 per cent had not moved or had moved only once in the five years prior to the study.

About 85 per cent of the families had only one child enrolled in the program, but some had two or three children enrolled. Sixteen per cent had a total of five or more children in the family.

Less than 15 per cent of the mothers were employed. Almost 60 per cent of the fathers were not employed. Average age of the mother was approximately thirty-one, and about 60 per cent of them had completed high school. Average age of the father was approximately thirty-five, and about 56 per cent had completed high school.

TEST INSTRUMENTS

Two tests were used to secure data directly related to confirming or denying the hypotheses of the study. One was a standardized test commonly used to measure the intelligence of children, the Peabody Picture Vocabulary Test. It was administered as a pretest and as a post-test. The second one was a curriculum specific test designed especially for the program. Named the Appalachia Preschool Mathematics Test, it was administered as a post-test only.

Peabody Picture Vocabulary Test (PPVT)

This test was selected for use because of its ease of administration, its relatively high correlation with other individual intelligence tests, and because its widespread

use in other investigations would allow some comparisons to be made.

The PPVT is an untimed individual test which can be administered in about fifteen minutes. It consists of a booklet with three practice and 150 test plates, each with four numbered pictures. The answer sheet gives the stimulus word for each item, the correct response number, and space to record the response of the subject. The examiner reads the stimulus word and the subject responds by pointing to, naming, or giving the number of the picture best illustrating the word. The examiner is not allowed to define or spell the word or otherwise assist the subject.

Not all items are administered to each subject. The manual suggests starting points for various ages, a basal level (eight consecutive right answers) is established, and the subject responds to each item until he reaches his ceiling (six wrong answers out of eight consecutive responses). Scoring is rapid and objective.

The total score can be converted to percentile rank, mental age, or standard score deviation IQ with a mean of 100 and a standard deviation of 15. Piers stated that:

> . . .from studies published in the manual and others published since, correlations with Stanford-Binet mental ages seem to be on the order of 70's and low 80's with IQ correlations running lower. With WISC IQ's they seem to be in the high 70's and low 80's. Correlations with three group intelligence tests are reported to be in the 60's, but the PPVT does not seem to correlate as highly with achievement test scores as do some of the group tests, although, as would be expected, coefficients are higher with reading or language than with other areas.[3]

---

[3]Ellen V. Piers, "Peabody Picture Vocabulary Test," The Sixth Mental Measurements Yearbook, (ed.) Oscar Krisen Buros (Highland Parks, New Jersey: The Gryphon Press, 1965), p. 530.

Appalachia Preschool Mathematics Test (APMT)

The APMT is an integral part of a longer test called the Appalachia Preschool Test of Cognitive Skills. The longer test consists of ninety-five items; the APMT is made up of forty-eight of these items. Personnel of the Appalachia Educctional Laboratory designed and constructed the test items directly from the behavioral objectives upon which the curriculum was based.

The items of the APMT are derived from those objectives relating to mathematical concepts. (See Appendix A.) Topics covered include Number, Size Relationship, Time, Seriation, Classification, Conservation, and Problem Solving.

Part I of the APMT was made up of twenty questions with right-wrong responses to examiner questions. Part II had twenty-eight questions, each with four possible responses, in a format very similar to that of the PPVT. (Refer to Appendix B for a copy of the test.)

When the specificity of the behavioral objectives is considered, it becomes apparent that test items are virtually defined by the objectives. On the basis of this specificity of objectives, face validity is claimed for the Appalachia Preschool Mathematics Test.

The format of the program was not conducive to administering the APMT as a retest, nor was it possible to write an equivalent form of the test. Reliability of the test scores has been estimated from a single administration of a single form of the test, employing the split-half method and applying the Spearman-Brown formula to estimate the reliability of the full test.[4] The APMT results gave a product-moment coefficient (r)

[4]Norman E. Gronland, Measurement and Evaluation in Teaching (New York: The MacMillan Co., 1965), pp. 84-85.

of .74 based on odd-even split halves, and a Spearman-Brown reliability of .85. The Appalachia Preschool Test of Cognitive Skills produced a reliability of .91.

SUMMARY

The Appalachia Preschool Education Program provided for intervention into the lives of three-, four-, and five-year-old children in Appalachia.

The intervention was planned and materials were developed by a curriculum materials team. These materials included television scripts and video tape recordings, printed materials for students, parents, and teachers to use, and activity guides for home visits and traveling classroom.

There were three elements to the intervention: television broadcasts of "Around the Bend," five days a week for thirty-four weeks; home visits, conducted weekly by paraprofessionals; and a traveling classroom, in which group activities were provided weekly for ten to fifteen children at a time.

It was hypothesized that mathematical behaviors of children exposed to the program would be different from those of children not so exposed; that the combination of three elements would be more effective than would television and home visits, and that either combination would be more effective than television alone; and that a home-oriented program would be an effective approach to providing a preschool program for rural children. A research design to test these hypotheses was drawn up. It provided for four treatments, with age and sex controlled.

The sample was located in four counties of southern West Virginia, with a control group located in Giles County, Virginia. The children were from rural farm or rural non-farm homes.

Two test instruments were used to secure data. The Peabody Picture Vocabulary Test, a standardized test commonly used to measure children's intelligence, was administered both as pretest and post-test. The Appalachia Preschool Mathematics Test, administered as a post-test, was designed especially for this study.

CHAPTER IV

ANALYSIS OF THE DATA

The data collected and anlyzed for the study will be presented in this chapter. Attention will be given first to the Peabody Picture Vocabulary Test (PPVT) pretest, post-test, and gain score results and an analysis of variance of these results. Consideration of the Appalachia Preschool Mathematics Test (APMT) will be divided into three parts: gross data on the results of Part I, Part II, and Total Test; analysis of variance of Part I, Part II, and Total Test; and performance on thirteen groups of items consisting of related mathematical concepts or skills. A summary concludes the chapter.

PEABODY PICTURE VOCABULARY TEST

The Peabody Picture Vocabulary Test was administered as a pretest and a post-test, with an interval slightly over seven months separating the two administrations. All testing was done in the children's home.

Test Results

Mean chronological age at the time of the pretest ranged from 52.26 months to 54.19 months among treatment groups, with a total sample (121 subjects) mean age of 52.93 months (S. D.=10.46). There was a mean lapse of 7.32 months between pretest and post-test for the total group, with a mean lapse (in months) of 7.55 for T_1, 7.11 for T_2, and 7.31 for each T_3 and T_4. Mean chronological age at the time of the post-test was 60.25 months for the total group, with the means of the four groups ranging from 59.81 months to 61.50 months.

For the PPVT pretest, mean raw scores of the four treatment groups ranged from 38.31 to 46.00, with a total group mean raw score of 43.17 points. These scores converted to IQ's show, by treatment groups, the following: T_1, a mean IQ of 97; T_2, a mean IQ of 101; T_3, a mean IQ of 97; and T_4, a mean IQ of 87. Total sample mean IQ was calculated to be 96.

Mean raw scores of the treatment groups ranged from 48.96 to 55.53 on the PPVT post-test. The total sample had a mean raw score of 52.98 points. Converted to IQ scores, the treatment groups scored as follows: T_1, a mean IQ of 109; T_2, a mean IQ of 109; T_3, a mean IQ of 101; and T_4, a mean IQ of 98. Total sample mean IQ was calculated to be 105 on the post-test.

All four treatment groups gained from PPVT pretest to post-test, both in raw score and in IQ score. The mean raw score and IQ gains respectively by groups, were as follows: T_1 - 11.82 and 12; T_2 - 9.52 and 8; T_3 - 7.28 and 4; and T_4 - 10.65 and 11. For the total sample the mean raw score gain was 9.81 and the mean IQ gain was 9 points.

Table III summarizes the results of the Peabody Picture Vocabulary Test pretest, post-test, and gain scores.

Analysis of Variance

An analysis of variance was performed on the PPVT pretest, post-test, and gain scores. The .05 level of significance was used as the criterion for rejecting the null hypothesis. This analysis indicated that there was a significant difference ($p<.001$) on the pretest for the effect of age. Treatment and sex failed to show significant differences. The PPVT is a test which is based on a presumption of age-related differences; to have found no difference would have been quite unusual.

TABLE III

PEABODY PICTURE VOCABULARY TEST DATA SUMMARY

Treatment Groups	Pretest Age Means	Between Test Interval Means	Post-test Age Means	Pretest Score Means	Pretest IQ* Means	Post-test Score Means	Post-test IQ* Means	Gain Score Means	IQ* Gain Means
T_1	52.26	7.55	59.81	43.71	97	55.53	109	11.82	12
SD	9.69	.62	9.78	15.35		13.67		13.93	
T_2	52.93	7.11	60.04	46.00	101	55.52	109	9.52	8
SD	10.52	1.52	10.85	10.61		10.91		9.39	
T_3	52.59	7.31	59.90	43.97	92	51.25	101	7.28	4
SD	11.20	1.07	11.26	13.75		12.16		9.83	
T_4	54.19	7.31	61.50	38.31	87	48.96	98	10.65	11
SD	10.49	.62	10.41	14.96		14.96		10.02	
Total	52.93	7.32	60.25	43.17	96	52.98	105	9.81	9

*IQ's were read from the conversion table in the PPVT manual.

The analysis of variance for the PPVT post-test again indicated a significant difference for age ($p < .001$) but not for sex. A significant difference was shown for treatment effect ($p < .036$). The Newman-Keuls Sequential Range Test[1] applied to treatment groups seemed to show that T_1 and T_2 were significantly better than both T_3 and T_4 at the time of the post-test. A significant difference ($p < .061$) for the treatment by sex interaction also appeared. The Newman-Keuls test indicated that T_1 boys were significantly better than T_3 girls and T_4 boys, and that all treatment by sex groups except T_3 girls were significantly better than T_4 boys.

Despite the apparent differences in the raw gain scores, there were no significant differences for the main effects of treatment, age, or sex. A similar treatment by sex interaction was the only significant difference ($p < .033$) disclosed by analysis of the PPVT gain scores. Control group (T_4) girls seemed to have gained significantly more than T_4 boys, T_1 girls, and both boys and girls of T_2 and T_3. The T_1 boys seemed to have gained significantly more than T_2 boys, T_1 girls, T_4 boys, and T_3 boys and girls.

Analysis of variance summary tables may be found in Appendix E.

The .05 level of significance was set as the criterion measure for rejecting the null hypotheses. Four null hypotheses were concerned with performance on the Peabody Picture Vocabulary Test.

Hypothesis 1. There are no differences between treatment groups as measured by the PPVT at the beginning of the intervention period.

---

[1] B. J. Winer, Statistical Principles: An Experimental Design (New York: McGraw-Hill Book Co., 1962), p. 80.

Analysis of variance on the post-test indicated a significant difference ($p > .036$) between treatment groups. The null hypothesis was rejected. Results from a Newman-Keuls Sequential Range Test provided evidence that T_1 and T_2 were significantly higher than T_3 and T_4.

Hypothesis 3. There are no differences between treatment groups as measured by gain scores on the PPVT.

The null hypothesis was not rejected; no significant differences between groups were shown by analysis of variance of the gain scores.

Hypothesis 4. There are no differences between boys and girls as measured by the PPVT.

Again, the null hypothesis was not rejected; analysis of variance on the pretest, post-test, and gain scores revealed no significant difference between boys and girls.

APPALACHIA PRESCHOOL MATHEMATICS TEST

The Appalachia Preschool Mathematics Test was administered as a post-test only. All testing was done in the children's homes.

Test Results

Part I of the APMT employed objects which could be manipulated to test conservation, seriation, and number terms. The child was also asked to tell his age and birth date. A total of twenty responses were called for.

Group T_2 had the highest mean score, with 15.55 points. It was followed by T_1 with a mean score of 13.76, T_3 with 12.69, and T_4 with 10.61 points. Mean score for the total sample (121 children) was 13.23 points.

Part II of the APMT required the child to select the correct response from an array of four pictorial presentations on each of twenty-eight items. These items were designed to test the child's understanding or knowledge of cardinal numbers, sets, geometric figures, classification, and number terms, along with other mathematical concepts and skills.

Group T_2 again had the highest mean score, 20.10 points, followed by T_1 with 17.29 points, and T_3 and T_4 only narrowly separated with 15.62 and 15.50 points respectively. For the total sample of 121 the mean score was 17.14 points.

Performance on the complete APMT, the sum of Part I and Part II, might be summarized as follows: T_2 had a mean score of 35.66, followed by T_1 with 31.06, T_3 with 28.31 and T_4 was last with a 26.12 mean score. The mean score for all boys was 30.23 compared to 30.52 for all girls. Mean scores by age groups were as follows: three-year-old group--25.76; four-year-old group--30.45; and five-year-old group--35.02. Table IV gives more complete data on the APMT test results.

Analysis of Variance

An analysis of variance was performed on Part I, Part II, and total APMT. The analysis indicated a significant difference ($p<.001$) on both treatment and age for Part I. The Newman-Keuls Sequential Range Test showed that T_2 was significantly better than T_1, T_3, and T_4, and that both T_1 and T_3 were significantly better than T_4.

The analysis of variance on Part II also indicated a significant difference ($p<.001$) for both treatment and age. The Newman-Keuls test showed that T_2 was significantly different from T_1, T_3, and T_4, but T_1, T_3, and T_4 were not significantly different from each other.

TABLE IV

APPALACHIA PRESCHOOL MATHEMATICS TEST
SCORES BY TREATMENT, SEX, AND AGE

Treatment Group	Sex		Age Three	Age Four	Age Five	All Ages
T_1	Boys	Mean	25.83	30.50	38.83	31.72
		S. D.	5.46	8.02	5.08	7.89
	Girls	Mean	30.17	26.75	32.83	30.31
		S. D.	6.27	5.68	2.93	5.16
	Total	Mean	28.00	29.00	35.83	31.06
		S. D.	5.79	6.72	4.83	6.78
T_2	Boys	Mean	34.75	34.75	40.00	36.77
		S. D.	.96	6.24	4.00	4.54
	Girls	Mean	29.33	37.00	39.00	34.75
		S. D.	4.50	6.52	5.10	6.46
	Total	Mean	31.50	36.00	39.50	35.66
		S. D.	4.18	5.75	4.13	5.77
T_3	Boys	Mean	19.50	33.00	34.50	28.76
		S. D.	1.05	7.21	7.97	8.86
	Girls	Mean	23.83	25.40	36.75	27.80
		S. D.	2.64	4.16	6.13	6.64
	Total	Mean	21.67	29.20	35.40	28.31
		S. D.	2.84	6.49	5.65	7.91

TABLE IV (continued)

Treatment Group	Sex		Age Three	Age Four	Age Five	All Ages
T_4	Boys	Mean	18.25	28.50	23.80	23.54
		S. D.	9.85	8.27	4.87	7.85
	Girls	Mean	24.50	27.40	34.50	28.69
		S. D.	3.42	8.56	11.03	8.35
	Total	Mean	21.37	27.89	28.56	26.12
		S. D.	7.11	7.46	8.91	8.51
Total	Boys	Mean	24.20	31.63	34.50	30.23
		S. D.	7.69	7.06	8.09	8.81
Total	Girls	Mean	27.18	29.26	35.63	30.52
		S. D.	4.98	7.42	6.23	7.19
Total Age Groups		Mean	25.76	30.45	35.02	30.37
		S. D.	6.59	7.34	7.31	8.05

For the total test, analysis of variance again indicated a significant different ($p<.001$) for both treatment and age. In this instance, T_2 was significantly better than T_1, T_3, and T_4, and T_1 was significantly different from T_4, as shown by the Newman-Keuls test.

Group T_1, with television, home visits, and traveling classroom elements, has been treated statistically as if all three elements were in operation for the duration of the intervention period. The fact that the traveling classroom was in operation for only the latter half of the intervention period may have had an effect on the performance of T_1.

In all three analyses the age-effect difference was such that the five-year-old group was superior to the four-year-old group, which in turn was superior to the three-year-old group.

Analysis of variance summary tables may be found in Appendix E.

The .05 level of significance was set as the criterion for rejecting the null hypotheses. There were five hypotheses which were concerned with performance as measured by the Appalachia Preschool Mathematics Test.

Hypothesis 5. There are no differences between treatment groups as measured by Part I of the APMT.

The null hypothesis was rejected. T_2 was shown to be significantly better than T_1, T_3, and T_4, and both T_1 and T_3 were significantly better than T_4.

Hypothesis 6. There are no differences between treatment groups as measured by Part II of the APMT.

The null hypothesis was rejected. It was shown that T_2 was significantly better than T_1, T_3, and T_4, but that T_1, T_3, and T_4 were not significantly different from each other.

Hypothesis 7. There are no differences between treatment groups as measured by the complete APMT.

The null hypothesis was rejected. On the complete test, T_2 was significantly better than T_1, T_3, and T_4, and T_1 was significantly better than T_4.

Hypothesis 8. There are no differences between boys and girls as measured by the APMT.

The null hypothesis was not rejected. Boys were not significantly different from girls on Part I, Part II, or the complete Appalachia Preschool Mathematics Test.

Hypothesis 9. There are no differences between three-, four-, and five-year-old children as measured by the APMT.

The null hypothesis was rejected. It was shown that performance of five-year-old children was superior to that of four-year-old children, and that the performance of four-year-old children was superior to that of three-year-old children.

The findings reported from the Peabody Picture Vocabulary Test and the Appalachia Preschool Mathematics Test were based on the results of an analysis of variance. Variates were: PPVT - pretest, post-test, and gain scores; APMT - Part I, Part II, and Total. An analysis of covariance was made on the same data, using the PPVT pre-test scores as the covariate and using as the variates the PPVT post-test and gain scores, and the APMT Part I, Part II, and Total scores. The analysis of covariance produced virtually no information beyond that obtained from the analysis of variance, so no attempt was made to report the results in this study.

Mathematical behavior by Item Groups

Items on the Appalachia Preschool Mathematics Test were grouped into thirteen

categories on the basis of mathematical skills and concepts, with the groups ranging in size from a minimum of two items to a maximum of eight items. Each category was considered separately. Table V lists the categories, the test items, and the number of items included in each category. Tests of statistical significance were not performed on the results of these item groups.

A. Conservation

> The concept tested was conservation of number. Two rows of checkers were displayed in one-to-one correspondence. Agreement was reached with the child that there was the "same number" of checkers in each row. One row of checkers was first extended, then compressed, then displayed randomly, and finally one checker was removed from one row. All operations were performed in the sight of the child. After each movement, the child was asked twice if the number of checkers was still the same.

Each child gave eight responses. The criterion measures established for the task classified those children with seven or eight correct responses as conservers, those with five or six correct responses as inconsistent conservers, and those with four or fewer correct responses as non-conservers. Table VI gives a complete report on the results in this category.

There were no conservers in the control group, while T_1 and T_2 each had one among the three-year-old children. Across total treatment groups, T_1 had seven conservers, T_2 had ten, T_3 had seven, and T_4 had no conservers.

B. Seriation and Serial Correspondence

> The test on seriation and serial correspondence was also conducted through the manipulation of objects. The objects in this instance consisted of a graduated series of cardboard disks, called "balloons," and a corresponding series of cardboard strips, called "sticks." The child was asked to arrange the "sticks" in a serial order, to place a missing "balloon" in its correct place in a serial order, to identify the "second" object in an array, and to maintain a serial correspondence after the physical correspondence was shifted.

TABLE V

CATEGORIES OF MATHEMATICAL BEHAVIORS, SHOWING THE TEST ITEMS AND NUMBER OF ITEMS INCLUDED IN EACH CATEGORY

Category	Number of Items in Category	Test Items for the Category
A. Conservation	8	Part I: 3-10 inclusive
B. Seriation and Serial Correspondence	6	Part I: 15-20 inclusive
C. Number Terms	7	Part I: 11-14 inclusive Part II: 3, 4, and 15
D. Geometric Figures	4	Part II: 1, 5, 16, and 20
E. Time Relationships	4	Part II: 11, 18, 27, and 28
F. Cardinal Number, Set	3	Part II: 6, 9, and 14
G. Identify Printed Symbols: Numerals	3	Part II: 2, 8, and 13
H. Positional or Spatial Terms	3	Part II: 12, 17, and 19
I. Matching Forms	2	Part II: 21 and 22
J. "Different"	2	Part II: 7 and 10
K. Classification	2	Part II: 23 and 24
L. Cause and Effect	2	Part II: 25 and 26
M. Age and Birth Date	2	Part I: 1 and 2

TABLE VI

CONSERVATION: PERFORMANCE RESULTS
BY TREATMENT AND AGE

Treatment Group	Age 3				Age 4				Age 5				Total			
	n	C	I	N	n	C	I	N	n	C	I	N	n	C	I	N
T_1	12	1	2	9	10	2	2	6	12	4	5	3	34	7	9	18
Per Cent		8	17	75		20	20	60		33	42	25		21	26	53
T_2	10	1	4	5	9	4		5	10	5	4	1	29	10	8	11
Per Cent		10	40	50		44		56		50	40	10		34	28	38
T_3	12		4	8	10	2	1	7	10	5	1	4	32	7	6	19
Per Cent			33	67		20	10	70		50	10	40		22	19	59
T_4	8		2	6	9		2	7	9		1	8	26		5	21
Per Cent			25	75			22	78			11	89			19	81
Total	42	2	12	28	38	8	5	25	41	14	11	16	121	24	28	69
Per Cent		5	29	67		21	13	66		34	27	39		20	23	57

n = number
C = Conservers (7-8 out of 8)
I = Inconsistent (5-6 out of 8)
N = Nonconservers (0-4 out of 8)

Each child gave six responses, with five or six correct responses required to meet the criterion for being classified as a seriator. In terms of treatment groups, only T_2 was clearly superior to the others, with 69 per cent of the group classified as seriators, T_1 with 44 per cent, T_3 with 37 per cent, and T_4 with 35 per cent so classified. Table VII gives a report by age and group for this category.

C. Number Terms

> This category included seven terms: same length, same size, longer, shorter, largest, smallest, and pair. The first four listed required the child to discriminate between or among objects used in the seriation task. The last three required the child to locate the correct pictorial representation from an array of four pictures.

For this category, raw scores were converted to percentage of correct responses. For total groups the scores were: T_2 - 90 per cent; T_1 - 81 per cent; T_3 - 80 per cent; and T_4 - 67 per cent. Table VIII reports percentage scores for this category in more detail.

D. Geometric Figures

> A knowledge of three plane figures and one solid figure was tested by four items. Each child was asked to select the correct response from among four pictorial representations of geometric figures. The responses called for were: circle, triangle, rectangle, and cylinder.

Raw scores, converted to a percentage of correct responses for each treatment group, indicated that T_2 was slightly superior to T_1 (65 per cent compared to 60 per cent), with T_3 (45 per cent) and T_4 (38 per cent) each lower than either T_1 or T_2. Table IX displays the scores in this category.

E. Time Relationships

> There were four items in this category. The child was required to recognize three o'clock and nine-thirty on a clock face, and

TABLE VII

SERIATION AND SERIAL CORRESPONDENCE: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Age 3		Age 4		Age 5		Total	
	n	S	n	S	n	S	n	S
T_1	12	3	10	2	12	10	34	15
Per Cent		25		20		83		44
T_2	10	5	9	6	10	9	29	20
Per Cent		50		67		90		69
T_3	12		10	3	10	9	32	12
Per Cent				30		90		37
T_4	8	1	9	5	9	3	26	9
Per Cent		13		56		33		35
Total	42	9	38	16	41	31	121	56
Per Cent		21		42		76		46

n = Number of children
S - Number of children able to seriate

TABLE VIII

NUMBER TERMS: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	81	80	82	81
T_2	81	87	96	90
T_3	63	80	91	80
T_4	60	73	68	68
Total	72	80	85	79

TABLE IX

GEOMETRIC FIGURES: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	48	55	96	60
T_2	57	64	75	65
T_3	35	60	52	45
T_4	31	53	61	38
Total	45	58	66	56

to point out "yesterday" and "tomorrow" on a calendar, when shown "today."

Performance was extremely low, with group scores, again converted to percentages, ranging from 32 per cent to 42 per cent of correct responses. From high to low the groups were T_2, T_4, T_1, and T_3. Table X reports the scores for this category in more detail.

E. Cardinal Number, Set

There were three items in this category. For each item the child was asked to point out the correct response from among four possible pictorial responses. The responses called for were: a set of three, a set of six, and the empty set.

Again, T_2 had the highest score, 86 per cent, followed by T_1 with 71 per cent, T_3 with 59 per cent, and T_4 with the low score of 51 per cent. Table XI reports the scores of this category in more detail.

G. Identify Printed Symbols: Numerals

While this category was closely related to the preceding one, there was a substantial difference in the skill required, since the symbol has no number quality of its own. Only as it is arbitrarily assigned to represent a number does the numeral acquire this quality. The three items in this category required the child to recognize, from an array of four numerals in each instance, the numerals for one, eight, and twelve.

Group T_2 was highest at 72 per cent, T_3 and T_1 close together at 56 per cent and 54 per cent respectively, and T_4 lowest at 49 per cent. Table XII presents the scores in this category in more detail.

A comparison of the scores in category F with those in category G indicated that performance in G was lower for all groups, and that, while groups T_3 and T_4 had only slightly lower scores (three percentage points) in category G than in category F,

TABLE X

TIME RELATIONSHIPS: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	29	25	42	32
T_2	35	50	42	42
T_3	21	35	37	30
T_4	16	33	47	33
Total	26	36	42	34

TABLE XI

CARDINAL NUMBER, SET: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	59	70	83	71
T_2	80	77	93	86
T_3	44	60	77	59
T_4	33	40	59	51
Total	55	85	79	67

groups T_1 and T_2 had appreciably lower scores (seventeen and fourteen percentage points respectively) on category G than on category F. No explanation for this was apparent.

TABLE XII

IDENTIFY PRINTED SYMBOLS, NUMERALS: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	42	53	67	54
T_2	47	81	90	72
T_3	31	60	83	56
T_4	33	52	59	49
Total	38	61	75	58

H. Positional or Spatial Terms

The three items in this category each required the child to select, from among four pictures containing the same objects, the one picture showing a given object in a specified relationship to the other object(s). The three terms tested were: between, under, and on.

Performance was generally good, and very little difference was shown either between groups or between ages. Only ten percentage points separated high score from low score (81 per cent to 91 per cent), and the control group (T_4) scored above both T_1 and T_3. Table XIII presents the data for this category.

TABLE XIII

POSITIONAL OR SPATIAL TERMS: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	86	80	94	87
T_2	87	96	90	91
T_3	75	87	83	81
T_4	96	93	78	88
Total	85	89	87	87

I. Matching Forms

A cube and a triangle were to be matched with the same shapes selected from among four possibilities in each of the two items in this category. The child was asked only to make the visual discrimination; labeling was not necessary

Group scores were as follows: T_2 - 95 per cent; T_3 - 92 per cent; T_1 - 85 per cent; and T_4 - 71 per cent. More complete data are presented in Table XIV for this category.

J. "Different"

Two items were used in testing this concept. By presenting to him an array of four pictures, three alike and one different, and asking him to select the one that was "different," the child's understanding of this concept was tested.

Scores appeared to cluster by groups, with T_2 and T_1 at 83 per cent and 79 per cent respectively, and T_3 and T_4 lower at 64 per cent and 63 per cent respectively. Table XV provides more detailed information on this category.

TABLE XIV

MATCHING FORMS: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	83	80	92	85
T_2	90	77	100	95
T_3	79	100	100	92
T_4	56	72	83	71
Total	79	89	99	89

TABLE XV

"DIFFERENT": PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	71	70	96	79
T_2	65	89	95	83
T_3	54	60	80	64
T_4	44	67	78	63
Total	60	71	88	73

K. Classification

The child was asked to pick out, from an array of four objects, the one which did not belong with the others. The first test item presented a group of three candles along with three groups of two candles each (classification by number). The second item presented a four-sided figure along with three triangles (classification by form).

Scores ranged from 37 per cent (T_3) to 62 per cent (T_2), with T_1 and T_4 clustered at 53 per cent and 56 per cent respectively. For more complete data, refer to Table XVI.

L. Cause and Effect

Two items were used to test the child's ability to relate a probable cause to an effect. In one item, a house was shown in flames. The pictures to which the child was to respond (indicating the cause of the fire) included lightning striking the house, the house under construction, a fire engine, and smoldering remains of a house. The second test item pictured a broken window, with the response to be selected from pictures of ball players in four different situations: sliding into base, catching a fly ball, passing a ball between two players, and a player batting a ball.

Scores fell within a rather narrow range from 50 per cent to 66 per cent. In ascending order, the group's scores were: T_1 - 50 per cent; T_3 - 55 per cent; T_4 - 60 per cent; and T_2 - 66 per cent. More detail is provided by Table XVII.

M. Age and Birth Date

Examiners engaged each child in a brief informal conversation before entering into the formal test session. As a transition, some questions were asked and answered orally at the beginning of the test session. Answers to these questions were recorded. Among them were: How old are you? When is your birthday? For the first test item the examiner accepted either the age in years or the proper number of fingers as a correct response. For the birth date both the month and date of the month were required for a correct response.

TABLE XVI

CLASSIFICATION: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	58	35	58	53
T_2	65	56	65	62
T_3	29	40	45	37
T_4	44	56	72	56
Total	49	45	61	52

TABLE XVII

CAUSE AND EFFECT: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Per Cent of Correct Responses			
	Age 3	Age 4	Age 5	All Ages
T_1	42	70	46	50
T_2	55	67	75	66
T_3	37	45	85	55
T_4	50	67	61	60
Total	45	62	66	57

Results were very much the same across treatment groups: most children knew their age, few children knew their birth date. Of the 121 children in the sample, 109 knew their ages, but only 28 knew their birth date. Table XVIII provides more detail.

Table XIX summarizes the performance on the APMT by categories of mathematical behaviors.

SUMMARY

Performance on the Peabody Picture Vocabulary Test, administered as a pretest, indicated that the four treatment groups were comparable at the beginning of the year. When the same test was administered at the end of the year, it appeared that the two groups receiving the most intensive intervention, T_1--with television, home visits, and traveling classroom--and T_2--with television and home visits--were significantly better than T_3--with television only--and T_4--with no intervention. Gain scores across treatment groups showed no statistically significant differences. There were no significant differences between boys and girls as measured by the PPVT.

The Appalachia Preschool Mathematics Test results indicated that the group receiving television and home visits (T_2) was significantly better than each of the other three treatment groups, and that the group receiving television, home visits, and traveling classroom (T_1) was significantly better than the control group (T_4). Performance of group T_1 may have been affected by the short period of time the traveling classroom was in operation. Boys and girls were not significantly different from each other as measured by the APMT.

TABLE XVIII

AGE AND BIRTH DATE: PERFORMANCE RESULTS BY TREATMENT AND AGE

Treatment Group	Age 3			Age 4			Age 5			Total		
	n	A	B	n	A	B	n	A	B	n	A	B
T_1	12	9	3	10	9	2	12	12	3	34	30	8
Per Cent		75	25		90	20		100	25		88	24
T_2	10	10		9	9	3	10	9	3	29	28	6
Per Cent		100			100	33		90	30		97	21
T_3	12	9	2	10	10	1	10	10	3	32	29	6
Per Cent		75	17		100	10		100	30		91	19
T_4	8	6	1	9	8	4	9	8	3	26	22	8
Per Cent		75	13		89	44		89	33		85	31
Total	42	34	6	38	36	10	41	39	12	121	109	28
Per Cent		81	14		95	26		95	29		90	23

n = Number of children
A = Numer of children who knew their age
B = Number of children who knew their birth date

TABLE XIX

SUMMARY OF PERFORMANCE ON MATHEMATICAL BEHAVIORS
BY TREATMENT EXPRESSED IN PERCENTAGES

Mathematical Behavior	T_1	T_2	T_3	T_4
A. Conservation	21	34	22	0
B. Seriation, Serial Correspondence	44	69	37	35
C. Number Terms	81	90	80	67
D. Geometric Figures	60	65	45	38
E. Time Relationships	32	42	30	33
F. Cardinal Number, Set	71	86	59	51
G. Printed Symbols: Numerals	54	72	56	49
H. Positional, Spatial Terms	87	91	81	88
I. Matching Forms	85	95	92	71
J. "Different"	79	83	64	63
K. Classification	53	62	37	56
L. Cause and Effect	50	66	55	60
M. Age	88	97	91	85
Birth Date	24	21	19	31
Total	65	74	59	54

Performance on both the PPVT and the APMT for five-year-old children was significantly better than that of four-year-old children, which in turn was significantly better than that of three-year-old children.

Statistical tests of significance were not run on the APMT after the results were divided into thirteen mathematical behavior item groups. When scores were converted into percentages, inspection showed that treatment group T_2 was superior on all thirteen categories. Treatment group T_1 was second on five categories, third on seven categories, and fourth on three categories. Treatment group T_3 was second on three categories, third on six categories, and fourth on four categories. The control group was second on five categories and fourth on eight categories. On the total APMT, scores were: T_1 - 65 per cent; T_2 - 74 per cent; T_3 - 59 per cent; and T_4 - 54 per cent.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

Early intervention into the lives of disadvantaged children has often been recommended, but few preschool programs exist in rural Appalachia. Mathematical concepts form one of the major areas of cognitive behavior, and the preschool years are critical in a child's development of these concepts.

A preschool program for three-, four-, and five-year-old children living in rural Appalachia, to be presented to them in or near their homes via television, home visits, and a traveling classroom, was proposed. Mathematical ideas and concepts were to be included in the curriculum.

The objective of the proposed program was the development of an approach which would provide a sound preschool program accessible to rural children, a program through which mathematical concepts would be effectively taught.

The Appalachia Preschool Education Program reported in this study consisted of three elements: A television broadcast over a commercial channel which could be received on home sets, with each broadcast lasting one-half hour, five days a week, for thirty-four weeks; home visitations, with the visits being made weekly by trained paraprofessionals over a period of thirty-four weeks; and, a traveling classroom which provided a setting for a group experience once each week. (Due to procurement difficulties, the traveling classroom operated for only seventeen weeks.)

The target population for the program consisted of preschool children, three, four, and five years of age, living in rural Appalachia. For this study a sample population was selected from an area of southern West Virginia composed of children within the appropriate age range and whose homes were rural farm or rural non-farm as defined by the United States Bureau of the Census. A comparable group of children from Giles County, Virginia, was selected as a control group.

It was hypothesized that there would be differences displayed between the mathematical behavior of children receiving the home-oriented preschool program and that of children not receiving such a program. It was expected that the combination of the three elements would be shown to be more effective than the combination of television and home visits, and that either combination would be more effective than would television alone. It was predicted that the study would show the home-oriented program to be an effective approach to providing a preschool program to rural children.

The sample from which data were collected for the study consisted of 121 children divided into four treatment groups, with each group structured into nearly equal numbers of boys and girls, and nearly equal numbers of three-, four-, and five-year-old children.

The four treatment groups were:

Treatment I (T_1) - Intervention through television broadcasts, home visits, and traveling classroom.

Treatment II (T_2) - Intervention through television broadcasts and home visits.

Treatment III (T_3) - Intervention through television broadcasts only.

Treatment IV (T_4) - No intervention.

Test instruments used to provide data for the study were the Peabody Picture Vocabulary Test and the Appalachia Preschool Mathematics Test. The PPVT, an individually administered intelligence test, provided pretest, post-test, and gain scores. The APMT, a curriculum specific test designed for this study, was administered as a post-test only. Analysis of variance and the Newman-Keuls Sequential Range Test were used to determine the statistical significance of the results.

These techniques indicated that the four treatment groups were not significantly different from one another at the beginning of the intervention period, as measured by the PPVT. Post-test results of the PPVT indicated that treatment groups I and II, which received the most intensive intervention, were significantly better than treatment groups III and IV. Gain scores did not show significant differences across treatment groups.

Results on the Appalachia Preschool Mathematics Test indicated that treatment group II, with television and home visits, was significantly better than each of the other three groups, and that treatment group I, with television, home visits, and traveling classroom, was significantly better than the control group.

Boys and girls were not significantly different from each other on any measure. On every measure, there was a significant difference among age groups in favor of the older children.

CONCLUSIONS

It was hypothesized that children who had received the Appalachia Preschool Education Program would display mathematical behavior different from that of children

who had not received the program. This was shown to be the case. Treatment group II, which had home visits and the television broadcast, and treatment group I, with home visits, television, and traveling classroom, were both significantly better than the control group, and treatment group III, television only, was higher on mean score than the control group. Although no test of statistical significance was made, mathematical behaviors which appeared to be particularly different in favor of the intervention groups included conservation of number, seriation, number terms, geometric figures, cardinal number and set, and matching forms. Behaviors which did not appear to be particularly different among the groups included knowledge of age and birth date, cause and effect, classification, positional and spatial terms, and time relationships. It was concluded that mathematical concepts and skills could be taught through a home-oriented preschool program.

It was expected that the combination of the three elements--television, home visits, and traveling classroom--would be more effective than would the two elements--television and home visits; that the two elements--television and home visits--would be more effective than one element--television; and that one element--television--would be more effective than no intervention. Evidence from the data was equivocal with regard to these expectations. The treatment group receiving two elements (T_2) was shown to be significantly better than the group receiving three elements (T_1), the group receiving one element (T_3), and the control group (T_4). Treatment group T_1 was shown to be significantly better than the control group. In descending order of mean scores on the APMT the groups were T_2, T_1, T_3, and T_4. It was concluded that a program of two elements (television and home visits) or three elements (television, home visits, and traveling classroom) would be effective in presenting a home-oriented preschool program, but that the television element alone would not be effective.

Failure of treatment group I, which received three intervention elements, to surpass treatment group II, which received only two elements, was contrary to expectation. It was expected that each element would have an additive effect, and perhaps that the whole would equal even more than the sum of the three parts in this case. Accepting the data at face value would lead to the conclusion that a group experience in a traveling classroom (the third element) was detrimental to the development of preschool children. While this may have been the case, it was considered unlikely.

Several possible explanations for the contradiction were advanced. It was thought possible that parents in group T_1 relied on the professional teacher in the traveling classroom and consequently worked less with their children than did the parents in T_2. This reliance may have also affected the regularity with which the children watched the television element of the program. It has been suggested that the children were busy learning other, non-cognitive skills in the traveling classroom, and thus learned fewer of the cognitive skills to which they were exposed. Starting the traveling classroom near the midpoint of the intervention (February 3, 1969) may have affected the results.

It was predicted that a home-oriented program would be an effective approach to providing a preschool program for rural Appalachian children. The three-element program described in this study was presented to a substantial number of rural Appalachian children, three, four, and five years of age, for a period of thirty-four weeks during the 1968-1969 school year. Some of the results have been described. The fact that the professional and paraprofessional members of the Appalachia Preschool Education Program were able to maintain schedules, meet deadlines, and provide instruction

through various media throughout the year indicated that it was physically possible to implement the program. The fact that parents and children remained with the program throughout the year and that cognitive behavior of the children was changed in favor of the intervention groups indicated that the products of the program were being used. It was concluded that the home-oriented approach, as described, would be an effective means of providing a sound preschool program to children of rural Appalachia.

While it was possible that a Hawthorne Effect was operating, the length of time over which the study was conducted would seem to make this unlikely.

RECOMMENDATIONS

There were several mathematical behaviors which were changed little, if any, by exposing children to this program. These behaviors need to be evaluated in terms of child growth and development and in terms of mathematical learning processes. If it should be found that these behaviors are important for the development of mathematical competency and are relevant to children in the age range toward which the program is aimed, an effort should be made to improve the effectiveness of the process used in developing these behaviors. If they are not important or relevant, these behaviors should be removed from the list of objectives, and the time previously devoted to them could be given to other learnings.

Group T_1 did not surpass group T_2 as was expected. Several possible explanations for this reversal were mentioned in the previous section of this chapter. Since the traveling classroom was the element of intervention which T_1 received but T_2 did not receive, it would appear that more information on the effectiveness of the traveling

classroom should be sought. Two lines of investigation should be followed: determine the effect of the traveling classroom on the learning of cognitive skills, with particular reference to mathematical skills; determine the effect of the traveling classroom on the learning of other skills, with particular reference to social skills.

The Appalachia Preschool Education Program, under the auspices of the Appalachia Educational Laboratory, was proposed as a three-year developmental and field demonstration effort. The three years would allow a child to start as a three-year-old and continue through the entire cycle of the program, eventually graduating into the first grade of the public schools. The full three years of development and field demonstration should be carried out. It is further recommended that an effort be made to follow the participating children another three years, until they have completed their third year of school. This would provide an opportunity to measure the persistence of effect of the program.

Based upon the evidence produced by a one-year field demonstration, it appears that the home-oriented approach to preschool education is an effective means to providing a sound program to children of rural Appalachia. It is recommended that any school system with preschool children living in sparsely settled areas consider this approach as an alternative to the traditional classroom kindergarten and nursery school program.

BIBLIOGRAPHY

A. BOOKS

Almy, Millie, with Edward Chittenden and Paula Miller. Young Children's Thinking. New York: Teachers College Press, Columbia University, 1966.

Beck, Lester F. Educational Media (TV) for the Preschool Child. Monmouth, Oregon: Oregon State System of Higher Education, 1965.

Bloom, Benjamin S. Stability and Change in Human Characteristics. New York: John Wiley and Sons, Inc., 1964.

Bruner, Jerome S. Toward a Theory of Instruction. Cambridge, Massachusetts: Harvard University Press, 1966.

Burgess, Evangeline. Values in Early Childhood Education. Washington: Department of Elementary Kindergarten-Nursery Education, NEA, 1965.

Buros, Oscar Krisen (ed.). The Sixth Mental Measurements Yearbook. Highland Park, New Jersey: The Gryphon Press, 1965.

Carnegie Corporation of New York. Public Television: A Program for Action. The Report of the Carnegie Commission on Educational Television. New York: Bantam Books, Inc., 1967.

Crow, Lester D., et. al. Educating the Culturally Disadvantaged Child. New York: David McKay Company, Inc., 1966.

Davis, Robert B. The Changing Curriculum: Mathematics. Washington: Association for Supervision and Curriculum Development, NEA, 1967.

Foster, Josephine and Headley, Neith E. Education in the Kindergarten, Fourth Edition. New York: American Book Company, 1966.

Gage, N. L. (ed.). Handbook of Research on Teaching. Chicago: Rand McNally and Co., 1963.

Garry, Ralph (ed.). For the young viewer; TV programming for children, at the local level. New York: McGraw-Hill Publishing Company, 1962.

Glennon, Vincent J. andCallahan, Leroy G. Elementary School Mathematics: A Guide to Current Research. Washington: Association for Supervision and Curriculum Development, NEA, 1968.

Gronlund, Norman E. Measurement and Evaluation in Teaching. New York: The MacMillan Company, 1965.

Hamlin, Ruth, et. al. Schools for Young Disadvantaged Children. New York: Teachers College Press, Columbia University, 1967.

Hechinger, Fred M. Pre-School Education Today. New York: Doubleday and Company, Inc., 1966.

Hooper, Frank H. and Marshall, William H. The Initial Phase of a Preschool Curriculum Development Project - Final Report. Morgantown: West Virginia University, 1968.

Hymes, Jr., James L. Early Childhood Education: An Introduction to the Profession. Washington: National Association for the Education of Young Children, 1968.

Klaus, Rupert A. and Gray, Susan W. Early Training Project for Disadvantaged Children: A Report After Five Years. Nashville, Tennessee: Peabody College for Teachers, 1967.

Leeper, Sarah Hammond, et. al. Good Schools for Young Children. New York: The MacMillan Company, 1968.

Mukerji, Rose. Television Guidelines for Early Childhood Education. Bloomington, Indiana: National Instructional Television Center, 1969.

Murphy, Judith and Gross, Ronald. Learning By Television. New York: The Fund for the Advancement of Education, 1966.

Passow, A. Harry, Goldberg, Miriam, and Tannenbaum, A. J. (eds.). Education of the Disadvantaged. New York: Holt, Rinehart and Winston, Inc., 1967.

Scott, Lloyd. Trends in Elementary School Mathematics. Chicago: Rand McNally and Company, 1966.

Sigel, Irving E. and Hooper, Frank H. (eds.). Logical Thinking in Children: Research based on Piaget's theory. New York: Holt, Rinehart and Winston, Inc., 1968.

Sunderlin, Sylvia (ed.). Children and TV: Television's impact on the child. Washington: Association for Childhood Education Internation, 1967.

Suppes, Patrick C. The development of mathematical concepts in children. Stanford, California: Stanford University, 1964.

Todd, Vivian Edmiston and Heffernan, Helen. The Years Before School: Guiding Preschool Children. New York: The MacMillan Company, 1964.

Wallis, W. Allen and Roberts, Harry V. Statistics: A New Approach. Brooklyn: The Free Press, Inc., 1956.

Weber, Evelyn and Sunderlin, Sylvia (eds.). New Directions in Mathematics. Washington: Association for Childhood Education International, 1965.

Westcott, Alvin M. and Smith, James A. Creative Teaching of Mathematics in the Elementary School. Boston: Allyn and Bacon, Inc., 1967.

B. PERIODICALS

Albera, Tosca E. "Readiness for Kindergarten," Education (November, 1962), 165-168

Allen, Gregory B. and Masling, Joseph M. "An evaluation of the effects of nursery school training on children in the kindergarten, first and second grades," Journal of Educational Research (December, 1957), 285-296.

Ashlock, R. B. "Planning mathematics instruction for four- ana five-year-olds," Arithmetic Teacher, 13:397-400, May, 1966.

Bachmeister, R. W. "Preparing preschoolers for the new math," Parents Magazine, 40:64-5, September, 1965.

Beard, Virginia. "Mathematics in Kindergarten," Education (March, 1965), 439-441.

Beck, L. F. "ETV for preschoolers," Audiovisual Instruction, 11:528-33, September, 1966.

"Big Preschool problems: space, money, and staff," Nation's Schools, 77:68, June, 1966.

Bloome, E. "How to put behavioral outcomes to work in kindergarten," Grade Teacher, 84:112-15, April, 1967.

Borum, Elizabeth A. and Livson, Norman. "Mental test score changes at kindergarten entry," The Journal of Experimental Education, Volume 34, Number 1 (Fall, 1965), 89-92.

Brazziel, W. F. and Terrell, Mary. "An experiment in the development of readiness in a culturally disadvantaged group of first grade children," Journal of Negro Education, Volume 31 (1962), 4-7.

Burns, Paul C. and Dessart, Donald J. "A summary of investigations relating to mathematics in elementary education: 1965," SchoolScience and Mathematics, 66:838-851, December, 1966.

Deutsch, Martin. "Facilitating development in the pre-school child: social and psychological perspectives," Merrill-Palmer Quarterly of Behavior and Development, Volume 10, Number 3 (July, 1964).

_____. "Nursery education: the influence of social programming on early development," The Journal of Nursery Education, Volume 18, Number 3 (April, 1963).

Dutton, Wilbur H. "Growth in number readiness in kindergarten children," The Arithmetic Teacher (May, 1963), 251-255.

_____. "Teaching time concepts to culturally disadvantaged primary-age children," The Arithmetic Teacher (May, 1967), 358-364.

Eads, Laura K. "Teaching mathematics in the kindergarten," Grade Teacher (October, 1958), 55, 134-135.

Garry, Ralph. "Television for children," Journal of Education. Boston: Boston University School of Education, Volume 150, Number 1 (October, 1967), 48.

Gilson, E. "Is nursery school necessary?", Saturday Review, 49:94, November 19, 1966.

Glennon, Vincent J. "Research needs in elementary school education," The Arithmetic Teacher (May, 1966), 363-368.

Gray, Susan W. and Klaus, A. "An experimental preschool program for culturally deprived children," Child Development (September, 1967), 819-826.

Hunt, J. McVicker. "The psychological basis for using pre-school enrichment as an antidote for cultural deprivation," Merrill-Palmer Quarterly of Behavior and Development, Volume, 10, Number 3 (July, 1964).

Kolson, Clifford J. "The oral arithmetic vocabulary of kindergarten children," The Arithmetic Teacher (February, 1963), 81-83.

Lehew, C. "Performance of four- and five-year-old children in Operation Head Start on selected arithmetic abilities," Arithmetic Teacher, 15:53-9, January, 1968 .

Mindess, M. and Keliher, A. V. "Review of research related to the advantages of kindergarten," Childhood Education, 43:505-12 (May, 1967).

Mitchell, M. M. and Spaulding, J. "Universal education for four-year-olds?", NEA Journal, 55:10-11 (November, 1966).

Montague, David O. "Arithmetic concepts of kindergarten children in contrasting socioeconomic areas," The Elementary School Journal (April, 1964), 393-396.

Olson, James L. and Larson, Richard G. "An experimental curriculum for culturally deprived kindergarten children," Educational Leadership (May, 1965), 553-558, 618.

Radin, Norma. "The impact of a kindergarten home counseling program," Exceptional Children (December, 1969), 251-256.

Riedesel, C. Alan, Suydam, Marilyn N., and Pikaart, Len. "Research on mathematics education, grades K-8, for 1967," The Arithmetic Teacher (October, 1968), 531-544.

Robeck, Mildred C. and Wilson, John A. R. "Comparison of Binet and the Kindergarten Evaluation of Learning Potential," Education and Psychological Measurement, Volume XXIV, Number 2 (1964), 393-397.

Roberts, D. M. and Bloom, I. "Mathematics in kindergarten: formal or informal?", Elementary School Journal, 67:338-41, March, 1967.

Sawada, Daiyo and Nelson, L. Doyal. "Conservation of length and the teaching of linear measurement: methodological critique," The Arithmetic Teacher (May, 1967), 345-348.

Schlinsog, G. W. "Mathematics in the Kindergarten?", The Arithmetic Teacher, 14:292-5, April, 1967.

_____. "More about mathematics in the kindergarten," The Arithmetic Teacher (December, 1968), 701-705.

Spayde, Paul E. "Kindergarten children's familiarity with measurement," Educational Research Bulletin (December 9, 1953), 234-238.

Summers, E. G. "Doctoral dissertation research in science and mathematics, report for 1964," School Science and Mathematics, 67:44-50, January, 1967.

Sutton, Rachel S. "A study of certain factors associated with reading readiness in the kindergarten," Journal of Educational Research (March, 1955), 531-538.

Suydam, Marilyn N. "The status of research on elementary school mathematics," The Arithmetic Teacher (December, 1967), 684-689.

"Teaching kids before they start school," Changing Times, 19:32-4, August, 1965.

Weaver, J. Fred. "Research on mathematics education, grades K-8, for 1965," The Arithmetic Teacher (May, 1966), 414-427.

Williams, Alfred H. "Mathematical concepts, skills, and abilities of kindergarten entrants," The Arithmetic Teacher (April, 1965), 261-268.

Wilson, John A. R. and Robeck, Mildred C. "A comparison of the Kindergarten Evaluation of Learning Potential (KELP), readiness, mental maturity, achievement, and ratings by first grade teachers," Educational and Psychological Measurement, Volume XXIV, Number 2 (1964), 409-414.

Wood, R. "Objectives in the teaching of mathematics," Educational Research, 10:83-98, February, 1968.

C. MISCELLANEOUS

Alford, Roy W., Jr. One-Room Schools in Appalachia. Charleston, West Virginia: Appalachia Educational Laboratory, Inc. (Mimeographed.)

Appalachia Educational Laboratory, Inc. Program Prospectus. Charleston, West Virginia: Appalachia Educational Laboratory, Inc., 1967. (Mimeographed.)

Defining Educational Objectives. A report of the Regional Commission on Educational Coordination and the Learning Research and Development Center. Pittsburgh: University of Pittsburgh Press, 1964.

Deutsch, Cynthia P. and Deutsch, Martin. "Brief Reflections on the Theory of Early Childhood Enrichment Programs." Paper read at the Social Science Research Council Conference on Early Childhood Education, Chicago, Illinois, February 7, 8, and 9, 1966.

Early Childhood Education. Report of the Southern Regional Conference on Early Childhood Education. Atlanta, Georgia: Southern Education Foundation, October, 1967.

Ellis, Richard R. "Educational Programming for Preschool Children." Paper read at the 44th Annual Convention of the Council for Exceptional Children, Toronto, Canada, April 22, 1966.

_____. "Innovations in the PreKindergarten Program." Paper read at the IDS Workshop-Conference, District 6M, New York, June 6, 1966.

Feldman, Carol Fleisher. Concept Formation in Children: A Study Using Nonsense Stimuli and a Free-Sort Task. Urbana, Illinois: National Laboratory on Early Childhood Education (undated). Document 70706-WG (1).

Fehr, Howard A. Needed Research in Mathematical Education. A report of a conference held at Greystone, New York, October 30 and 31, 1965. New York: Teachers College Press, Columbia University.

Fletcher, Harold J. and Garske, John P. Logical Inference in Discrimination Learning of Young Children. Madison, Wisconsin: Wisconsin Research and Development Center for Cognitive Learning, The University of Wisconsin. Technical Report Number 50.

Greenfield, Patricia Marks. Teaching Mathematical Concepts to Two- and Three-Year-olds: Some Experimental Studies. Urbana, Illinois: National Laboratory on Early Childhood Education (undated). Document Number 707-6-5-AD-6-11.

Hall, Vernon C., et. al. Cognitive Synthesis, Conservation and Task Analyses. Urbana, Illinois: National Laboratory on Early Childhood Education (undated).

"Head Start Childhood Research Information Bulletin," Childhood Resources Information Bulletin, Volume 1, Number 2 (Fall, 1969). ERIC Clearinghouse on Early Childhood Education, Urbana, Illinois.

Hess, Robert D. Maternal Behavior and the Development of Reading Readiness in Urban Negro Children. Urbana Illinois: National Laboratory on Early Childhood Education (undated). Document Number 70706-XG (9).

Hobson, Arline. Teachers and the Education of Aides. Urbana, Illinois: National Laboratory on Early Childhood Education (undated). Document Number 70706-A-DA-J-02.

"Mathematics," Journal of Research and Development in Education, Volume 1, Number 1 (Fall, 1967). Proceedings of the National Conference on Needed Research in Mathematics Education. Athens, Georgia: University of Georgia.

Meyer, William J., Cohen, Harvey, and Goldstein, David. Measuring Perceptual Motor Ability in Preschool Children. Urbana, Illinois: National Laboratory on Early Childhood Education (undated). Document Number 70706-S-A-O-Y-10.

Nehrt, Roy C. and Hurd, Gordon E. Preprimary Enrollment of Children Under Six: October, 1968. National Center for Educational Statistics, United States Department of Health, Education, and Welfare. Washington: Government Printing Office, 1969.

Scott, Myrtle, Eklund, Susan J., and Miller, James O. An Analysis of Early Childhood Education Research and Development. Urbana, Illinois: National Laboratory on Early Childhood Education, 1969. Document 70706-N-BA-R-11.

Teaching By Television. A report from The Ford Foundation and The Fund for the Advancement of Education. New York: The Ford Foundation, 1961.

APPENDICES

APPENDIX A

SELECTED BEHAVIORAL OBJECTIVES RELATED TO MATHEMATICAL CONCEPTS

The following educational objectives, stated in behavioral terms, are from a list of objectives for preschool children prepared by Hooper and Marshall of West Virginia University. The list of objectives was compiled for the Appalachia Educational Laboratory under the terms of a subcontract dated November 20, 1967, and may be found on pages 97-169 of The Initial Phase of a Preschool Curriculum Development Project, Final Report (Morgantown: West Virginia University, 1968).

Numbering and lettering from the original, complete listing was retained, so that this partial listing may be quickly referenced to the original and so that the reader may perceive the manner in which these objectives are embedded in the total range of cognitive behavioral objectives.

The objectives in the following list were selected as the basis for the Appalachia Preschool Mathematics Test (Appendix B).

BEHAVIORAL OBJECTIVES

Cognition

Part 1: Sensory Discrimination

II. PERCEPTUAL DISCRIMINATION

D. Distance

1. Given a question asking to name something 'near, far, close to, beside,' in relation to a starting point, name an appropriate object occupying the position named by the question. (The apple is near the pear.)

E. Form Recognition

1. Child matches forms.

b. Given an array of plane or solid figures, select the one that matches a model. The array may differ in size, color and material from the model. Discrimination required should become progressively finer as the child's skill develops.

3. Given an array of plane or solid geometric figures, child identifies all the basic shapes.

6. Child identifies printed symbols.

F. Number

1. Cardinal Number

a. Child understands cardinal number when he is able to:

1) Construct a one to one correspondence between two sets of objects.

2) Conserve this correspondence when it is no longer perceptually obvious.

d. Given a quantity of objects and a direction to group a certain number of the objects, count out and separate the number indicated.

f. Given one to five objects in a set compactly arranged, **name the number of objects without counting. Begin** with recognizing a set of one and build to a set of five.

2. Ordinal Number--Child understands ordinal numbers when he **is able to:**

a. Arrange in a sequence a set of objects which differ in some aspect (seriation).

d. Conserve an ordinal correspondence b[illegible]een two sequences of objects.

1) Find an object in an unordered set (but a set which is capable of being ordered) which corresponds to a given object in an ordered set.

3. Number Terms

G. Sequence

1. Child arranges events according to their sequence in time.

c. Arrange a series of pictures in order to match the sequence of a story.

H. Size relationship

1. Child indicates whether two objects are the SAME size or DIFFERENT.

c. Given an array of sticks of various lengths, circles of various diameters, or solid geometric figures, select the one that is the same size as a model. Eventually the child should be able to select a matching item without trial and error.

2. Child arranges articles according to increasing-decreasing size.

a. Given a set of similar objects differing only in size, put them in order from the smallest to the largest.

b. Given an incomplete sequence of sized articles and the missing articles, place those articles in the sequence without trial and error.

3. Child identifies and applies terms dealing with size relationships.

J. Time

1. Child identifies and applies time related terms.

Part 2: Higher Order Cognitive Acts

II. QUANTITATIVE SKILLS

A. Child can distinguish between objects by measurement.

1. Visual transfer

a. Given two rods (or other objects), state whether or not they are equal in length.

b. Given two rods held together, state which is longer, which is shorter.

B. Child can use numbers.

1. State his age in years; state his birth date.

2. State how many objects are in a set (including the empty set).

3. Given a cardinal number (9) and a set of small identical objects (disc counters), place the same number of objects below a number as the given number names.

4. Given an ordered set, identify the first, second, third, etc., items.

5. Read and write one-digit and multi-digit numerals from one to twelve.

6. Match numerals with sets of appropriate number.

C. Child can see the relationships of sets.

1. Given two sets of objects, state whether the sets are of equal size.

2. Given two unequal sets, state which has more (fewer) objects.

3. Given an array of sets of various sizes, order them from smallest to largest.

4. Identify an empty set as a set containing no objects. (How many children have three legs?)

5. Given a set, partition it into two more subsets and state that the subsets are smaller than, and belong to, the major set.

6. Given a set of objects (one to four members, locate the set verbally, name the objects in the set, and name the number of objects.

III. SERIATION TASKS

A. Seriation. Child arranges in a sequence a set of objects which differ in some attribute.

IV. CLASSIFICATION

A. Child classifies objects considering an increasing number of dimensions.

1. Developmental Sequence

c. SOME and ALL. Given a set of objects differing in color and shape, (six blue figures (four boxes, two balls), six red figures (all boxes)) and questions testing understanding of SOME and ALL answer correctly. (Are all of the reds boxes? Are all of the boxes red? Are all of the balls blue? Are all of the blues boxes?)

2. The child uses the terms SAME and DIFFERENT correctly.

C. Child classifies objects on different bases.

2. Child classifies objects according to number and size.

V. CONSERVATION

A. Conservation of Number

1. Child arranges objects by matching them on a one to one basis.

a. Given a set of objects, indicate the number of objects by holding up a corresponding number of fingers.

b. Given two related sets, match the members of one set to the members of another set. (Match a set of spoons to a set of forks.)

c. Given two sets of objects, name the number of objects in each set, and state whether there is a matching item in the second set of each item in the first set. (Given a set of spoons and a set of bowls, answer the question, "Is there one spoon for each bowl?")

d. Given two related sets of items (number of boxes and lids) state whether the one group of items has as many as another group.

4. Child identifies the equality of sets of objects even after physical correspondence is destroyed.

5. Given unequal sets of objects, the members of which are moved about, the child indicates which group has more, which group has less and maintains this viewpoint despite the moving of the objects.

VI. PROBLEM SOLVING

A. Logical Reasoning

2. Child completes short term sequences so they remain consistent with clues that have been given.

a. Given sequence cards (an apple being gradually eaten), arrange the cards in the appropriate order.

3. Child infers through creating, selecting and/or rejecting solutions to hypothetical problem situations.

a. Given a problem with a variety of possible solutions, select the one best suited to the situation. (If you are hungry at school, whom would it be best to ask for food--a friend, your mother, or a teacher?) Justify the response given.

4. Child infers by logical inclusion or exclusion.

a. Child identifies the one that is different in an array of items or incidents.

1) Given a drawing of three like forms and one different form, select the one that is different.

B. Problem Attack

2. Child chooses materials to be used in problem solving based on the attributes of the problem.

b. Sort objects according to possible function in solving a problem. (To make a drawing, paper and a marking instrument will be needed, not scissors.)

4. Location of Points

b. Child, using a two-dimensional map, locates points or paths on the map.

1) Find a location described in terms of the objects there.

2) Describe a location orally in terms of the objects at the locations.

3) Find a location described in terms of its positional location to other objects.

4) Describe a location by stating its positional locations (near, above, below) with reference to another object.

5) Trace a described route, passing designated places in designated order.

6) Name all the points that would be passed taking a given route between point x and point y.

7) Describe a route a person has followed.

APPENDIX B

APPALACHIA PRESCHOOL MATHEMATICS TEST

Part I

Name _____ Sex: M F Code _____

Treatment Group _____ Examiner _____

Part I	____
Part II	____
Total	____

	Year	Month	Day
Date	____	_____	____
Born	____	_____	____
Age	____	_____	____

In conversation, ask the child:

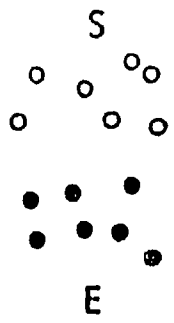
Right	Wrong	
____	____	1. How many years old are you?
____	____	2. When is your birthday?

CONSERVATION OF NUMBER

Materials: Seven (7) red and seven (7) black checkers.

Warm-Up: Place the red checkers in front of the subject and the black checkers in front of the examiner in random order.

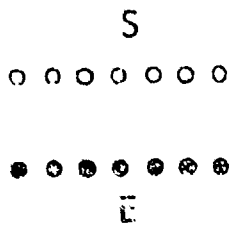
Figure 1.



E: NOW WATCH WHAT I DO. (Line the black checkers in a row in front of the examiner.)

E: PLACE YOUR CHECKERS IN A ROW LIKE THIS. (Assist if necessary so that this arrangement results:)

Figure 2.

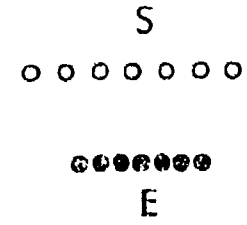


E: DOES THIS ROW HAVE THE SAME NUMBER OF CHECKERS AS THAT ROW? (If no, assist child to see equality by counting together, touching checkers together along the row, etc.) After getting a "yes" answer, say:

E: DOES ONE ROW HAVE MORE CHECKERS? (If "yes," again establish equality as above. After a "no" answer, proceed to next item. From here, go straight through the test regardless of the subject's answer to a given question.)

E: THIS ROW HAS THE SAME NUMBER OF CHECKERS AS THAT ROW. NOW WATCH WHAT I DO. (Slide the black checkers together to show:)

Figure 3.



Right Wrong

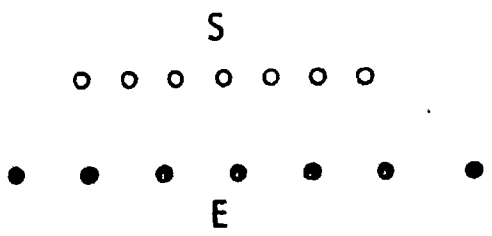
____ ____ 3. DOES THIS ROW HAVE THE SAME NUMBER OF CHECKERS AS THAT ROW? (Record answer.)

____ ____ 4. DOES ONE ROW HAVE MORE CHECKERS? (Record answer.)

Return black checkers to their position in Figure 2.

E: THIS ROW HAS THE SAME NUMBER OF CHECKERS AS THAT ROW. NOW WATCH WHAT I DO THIS TIME. (Slide the black checkers apart to show:)

Figure 4.



Right Wrong

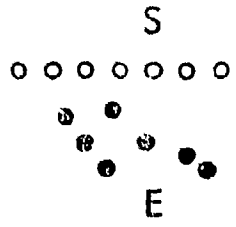
___ ___ 5. DOES THIS ROW HAVE THE SAME NUMBER OF CHECKERS AS THAT ROW? (Record answer.)

___ ___ 6. DOES ONE ROW HAVE MORE CHECKERS? (Record answer.)

Return black checkers to their position in Figure 1.

E: THIS ROW HAS THE SAME NUMBER OF CHECKERS AS THAT ROW. NOW WATCH WHAT I DO THIS TIME. (Slide the black checkers around to show:)

Figure 5.



Right Wrong

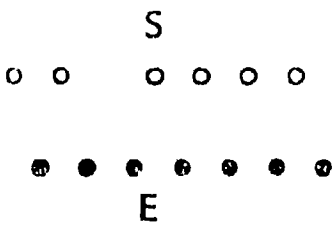
___ ___ 7. DO WE HAVE THE SAME NUMBER OF BLACK CHECKERS AS WE DO RED CHECKERS? (Record answer.)

___ ___ 8. DO WE HAVE MORE OF ONE THAN THE OTHER?

Return black checkers to their position in Figure 2.

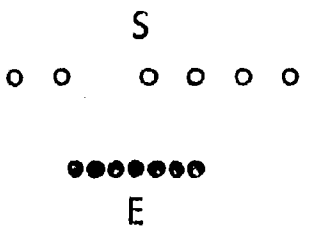
E: GIVE ME ONE OF THE RED CHECKERS. (Put out of sight.) NOW THERE ARE MORE OF THE BLACK CHECKERS.

Figure 6.



NOW, WATCH WHAT I AM DOING. (Slide the black checkers together to show:)

Figure 7.



Right Wrong

___ ___ 9. DOES THIS ROW HAVE THE SAME NUMBER OF CHECKERS AS THAT ROW? (Record answer.)

___ ___ 10. DOES ONE ROW HAVE MORE CHECKERS? (Record answer.)

SERIATION AND SERIAL CORRESPONDENCE

Materials: Cardboard "balloons" and "sticks." 6 ballons, 2", 3", 4", 5", 6"and 6" in diameter; 6 sticks 1/2" wide and 2", 3", 4", 5", 6", and 6" in length.

Place the cardboard sticks in a random order. Explain to the child that they are "cardboard sticks." Place the two 6" sticks side by side on the table and draw the child's attention to them.

Right Wrong

___ ___ 11. ARE THESE TWO STICKS THE SAME LENGTH? (Record answer.)

Place one of the 6" sticks and the 5" stick before the subject, and ask the subject,

___ ___ 12. WHICH STICK IS LONGER? SHOW ME THE LONGER STICK. (Record answer.)

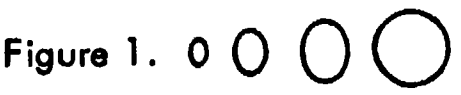
___ ___ 13. WHICH STICK IS SHORTER? SHOW ME THE SHORTER STICK. (Record answer.)

Lay sticks aside and display the balloons in front of the subject. Draw his attention to one of the 6" balloons.

___ ___ 14. CAN YOU FIND ONE THAT IS THE SAME SIZE AS THIS ONE? If no response say: SHOW ME ANOTHER ONE LIKE THIS ONE. (Record answer.)

Remove 5" balloon and one of the 6" balloons from the table.

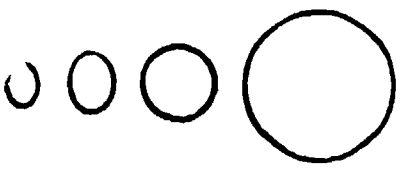
CAN YOU FIND THE SMALLEST BALLOON? WHICH IS THE SMALLEST? (Assist if necessary.) START WITH THE SMALLEST AND PUT THEM IN ORDER FROM THE SMALLEST TO THE LARGEST. (Assist if necessary.) This arrangement should result:

Figure 1. 

Give the child the 5" balloon and say,

___ ___ 15. CAN YOU PLACE THIS BALLOON IN THE ROW WHERE IT BELONGS? WHERE DOES IT GO? (Record answer.)

After recording answer to #5 above, assist child to complete the correct sequence.

Figure 1. 

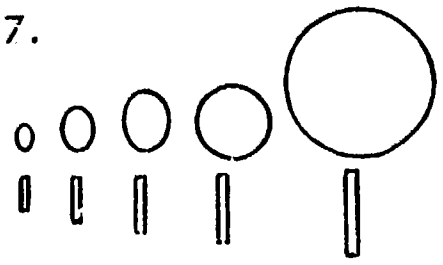
___ ___ 16. IF YOU START FROM THIS END (indicating the smallest balloon), WHICH IS THE SECOND BALLOON? SHOW ME THE SECOND BALLOON. (Record answer.)

Give the child the five sticks.

___ ___ 17. THE STICKS CAN BE ARRANGED JUST LIKE THE BALLOONS. START WITH THE SHORTEST STICK AND ARRANGE THE STICKS FROM THE SHORTEST TO THE LONGEST. THERE WILL BE ONE STICK FOR EACH BALLOON. Place the shortest stick under the smallest balloon if necessary. (Record answer.)

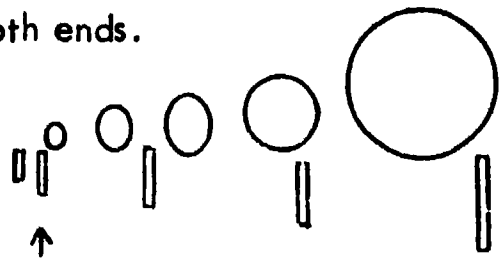
Arrange sticks and balloons as shown below if subject is unable to complete number 17.

Figure 3.



NOW WATCH WHAT I AM GOING TO DO. Move sticks to extend the row at both ends.

Figure 4.

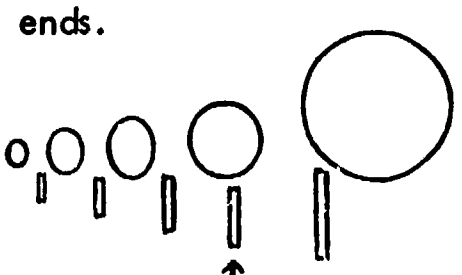


___ ___ 18. WHAT BALLOON GOES WITH THIS STICK? Point to second stick. (Record answer.)

Pick up the sticks and return them to the position shown in Figure 3.

NOW WATCH WHAT I AM GOING TO DO. Move sticks to compress the row at both ends.

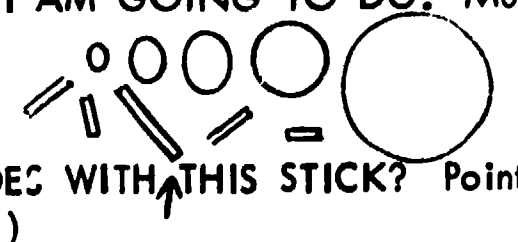
Figure 5.



___ ___ 19. WHAT BALLOON GOES WITH THIS STICK. Point to the fourth stick. (Record answer.)

Pick up the sticks and return them to the position shown in Figure 3.

NOW WATCH WHAT I AM GOING TO DO. Move sticks to the following arrangement.



___ ___ 20. WHAT BALLOON GOES WITH THIS STICK? Point to the longest stick. (Record answer.)

APPALACHIA PRESCHOOL MATHEMATICS TEST

Part II

Name _____ Sex: M F Age _____

Treatment Group _____ Examiner _____

Example A: LOOK AT EACH OF THESE PICTURES CAREFULLY. SHOW ME (point) A DRUM (1)

Child's Response

_____ 1. circle (4)
_____ 2. numeral one (3)
_____ 3. largest ball (3)
_____ 4. pair (1)
_____ 5. triangle (3)
_____ 6. set of three (3)
_____ 7. dog that is different (4)
_____ 8. numeral eight (1)
_____ 9. set of six (1)
_____ 10. flower that is different (1)
_____ 11. three o'clock (3)
_____ 12. butterfly between the flowers (2)
_____ 13. numeral twelve (2)
_____ 14. empty set (4)
_____ 15. smallest rabbit (3)
_____ 16. cylinder (1)
_____ 17. kitten under the basket (4)
_____ 18. nine thirty (3)
_____ 19. dog on the house (1)
_____ 20. rectangle (2)

_____ 21. WHICH OF THESE FOUR PICTURES IS THE SAME SHAPE AS THIS ONE (center)? (1)

_____ 22. WHICH OF THESE FOUR PICTURES IS THE SAME SHAPE AS THIS ONE (center)? (2)

Example B: THREE OF THESE PICTURES ARE ALIKE IN SOME WAY. THE OTHER ONE IS DIFFERENT. WHICH ONE IS DIFFERENT? Correct child if he misses the item. (Three animals and one toy which is different.) Proceed to items 23 and 24.

_____ 23. WHICH ONE IS DIFFERENT FROM THE OTHERS? (1)
_____ 24. WHICH ONE IS DIFFERENT FROM THE OTHERS? (2)

Example C: WHICH ONE OF THESE FOUR PICTURES DO YOU THINK CAUSED THE CHAIR TO BE BROKEN (number 3)? Correct child if he misses and proceed to items 25 and 26.

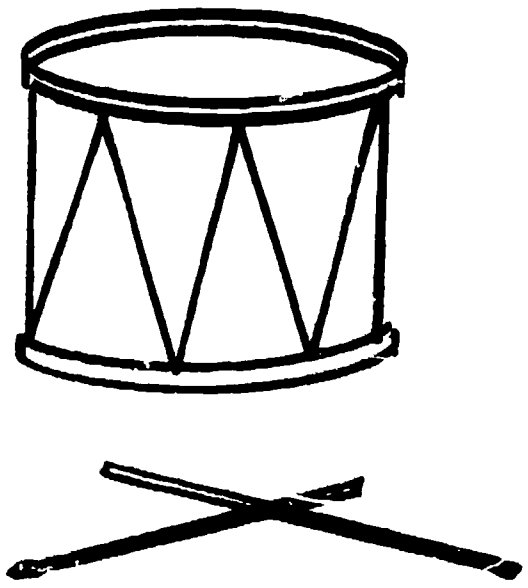
_____ 25. WHICH OF THESE CAUSED THIS? (1)
_____ 26. WHICH OF THESE CAUSED THIS? (4)

HERE IS A PICTURE OF THE MONTH OF JUNE. THIS IS TODAY. (Point)

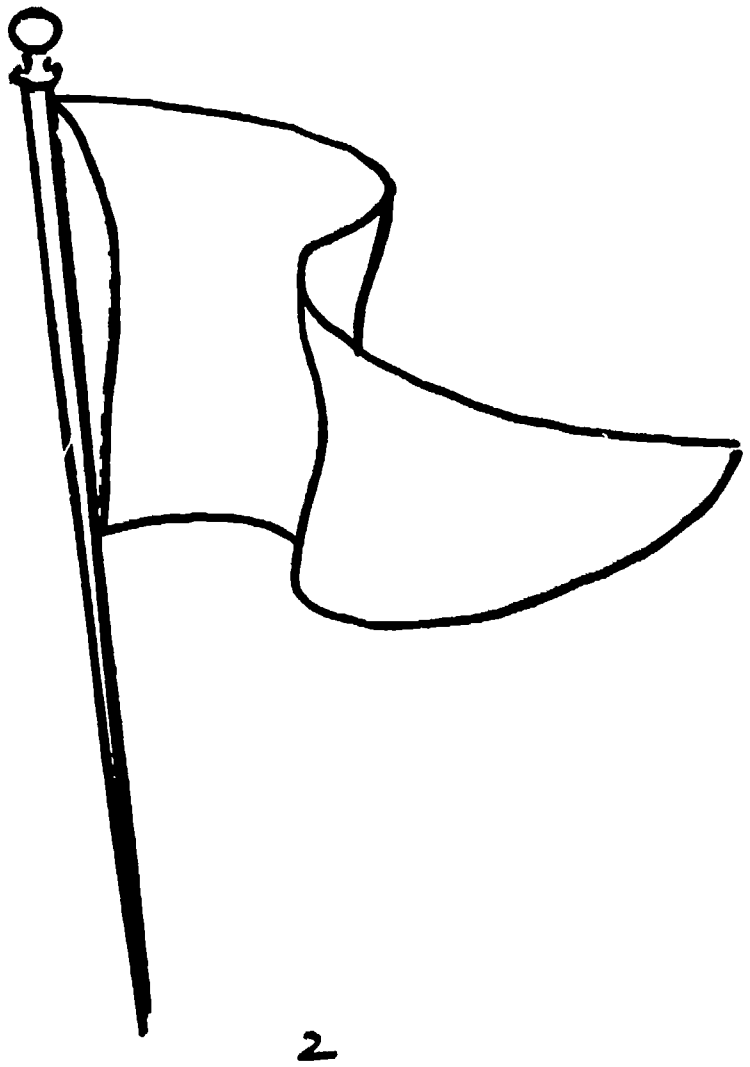
Right	Wrong	
___	___	27. SHOW ME YESTERDAY.
___	___	28. SHOW ME TOMORROW.

EXAMPLE A

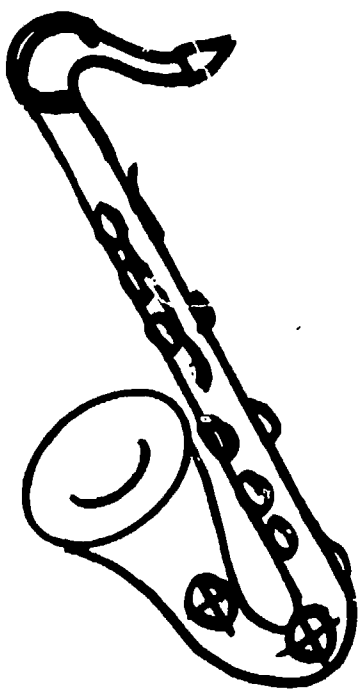
111



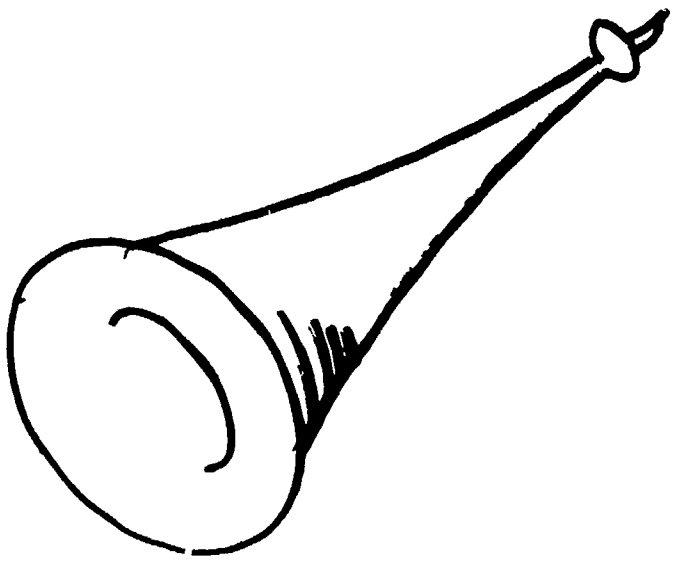
1



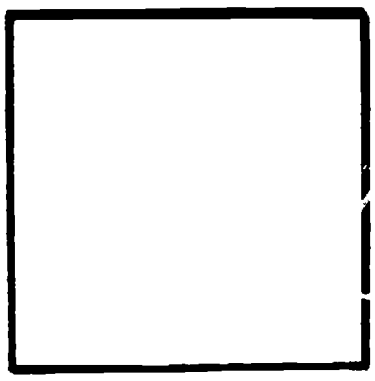
2

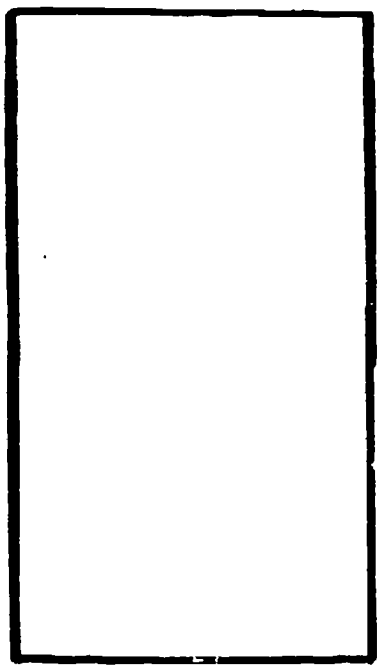


3



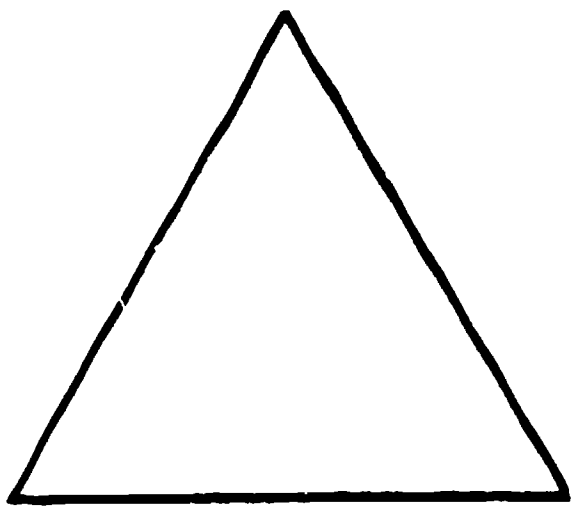
4

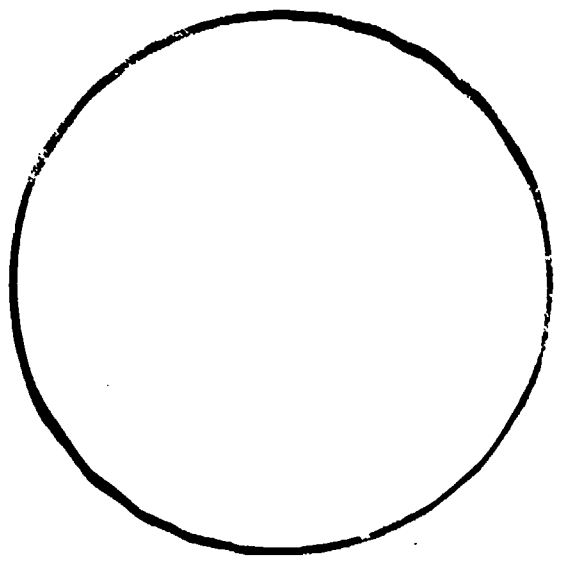




1

2



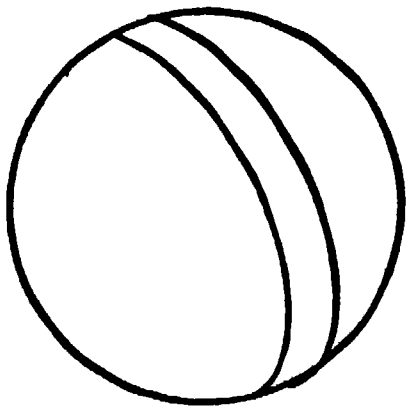


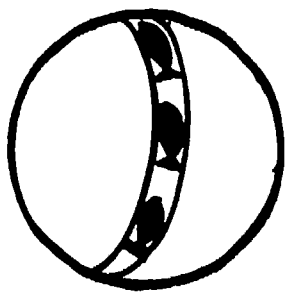
3

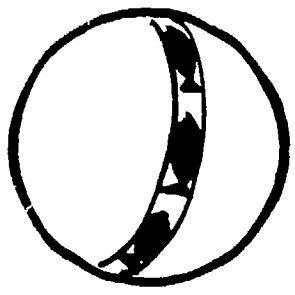
4

1	2
3	4

3

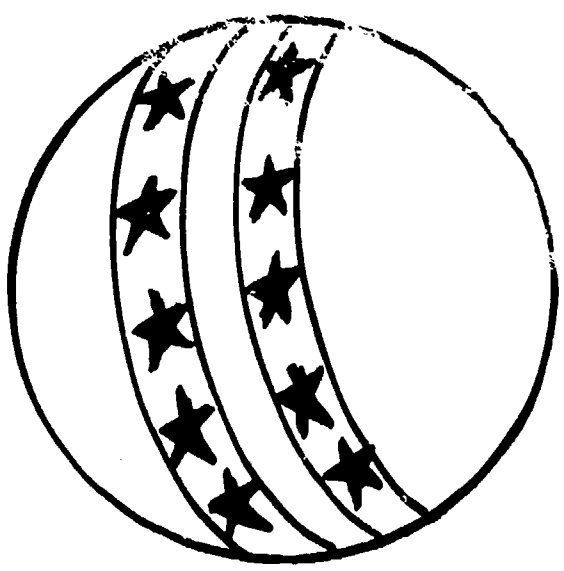


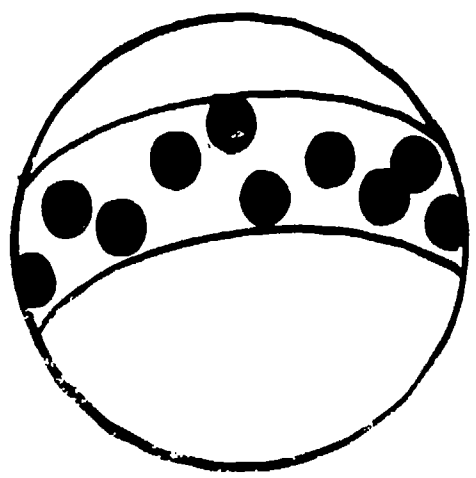




1

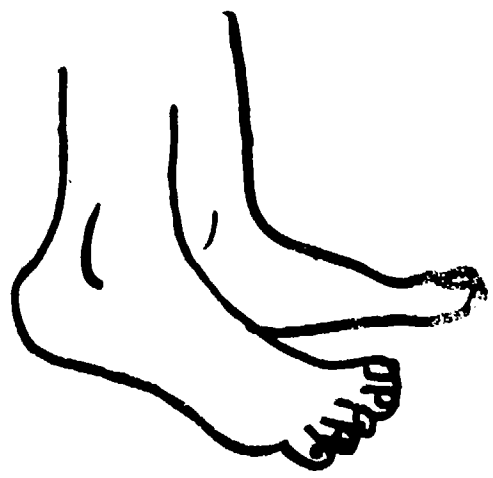
2

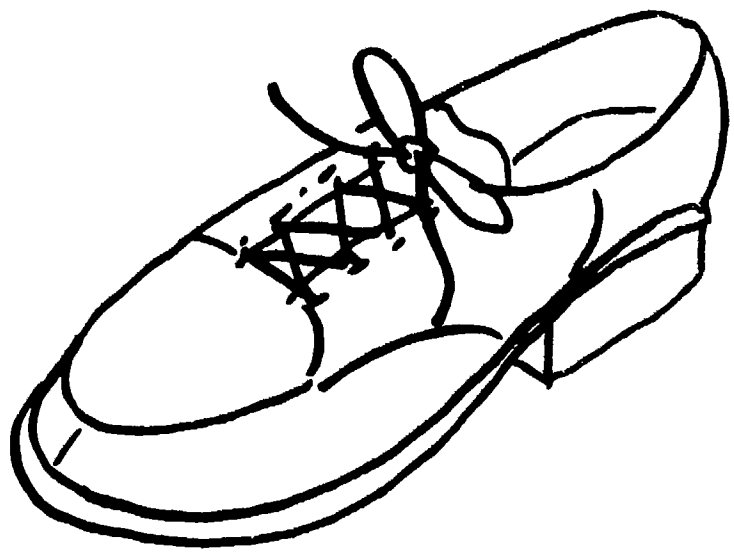




3

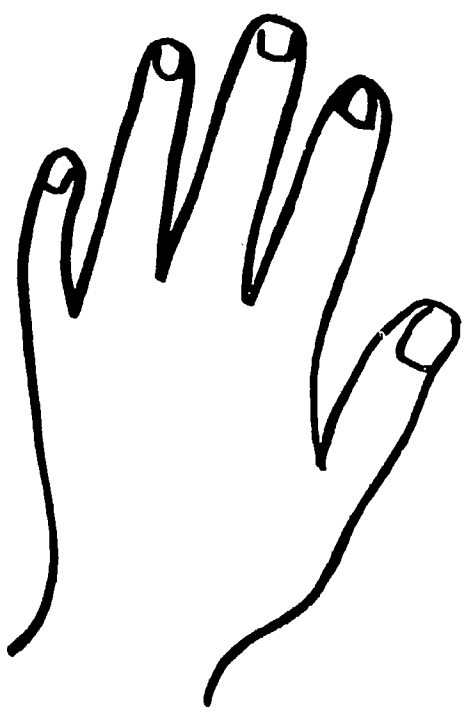
4

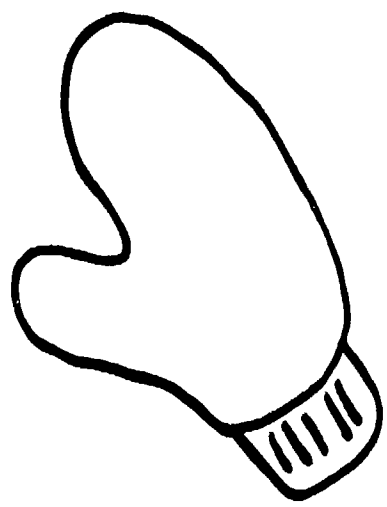




1

2

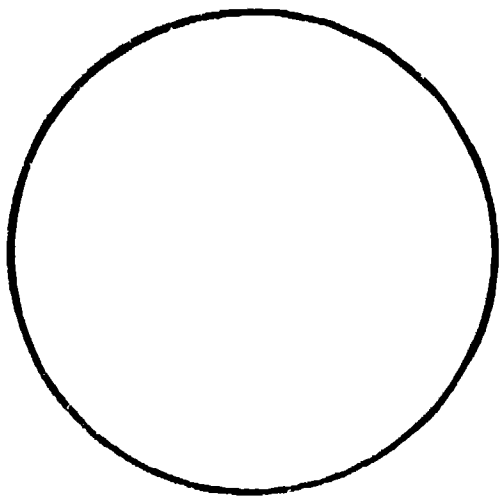


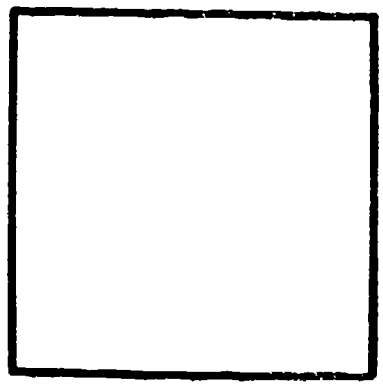


3

4

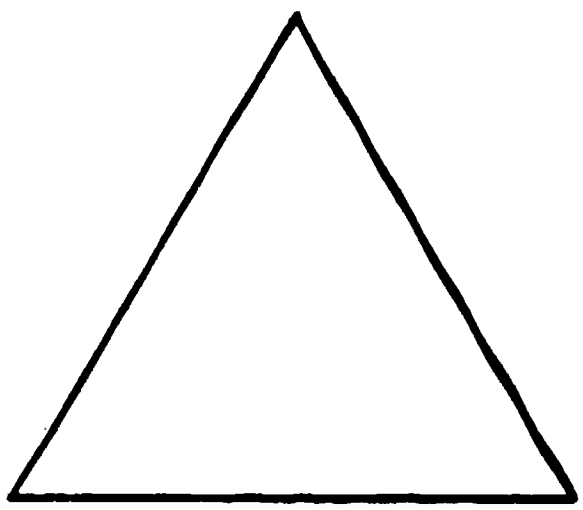
5

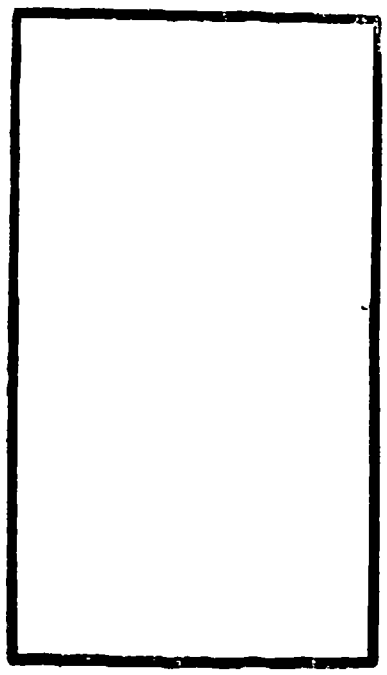




1

2

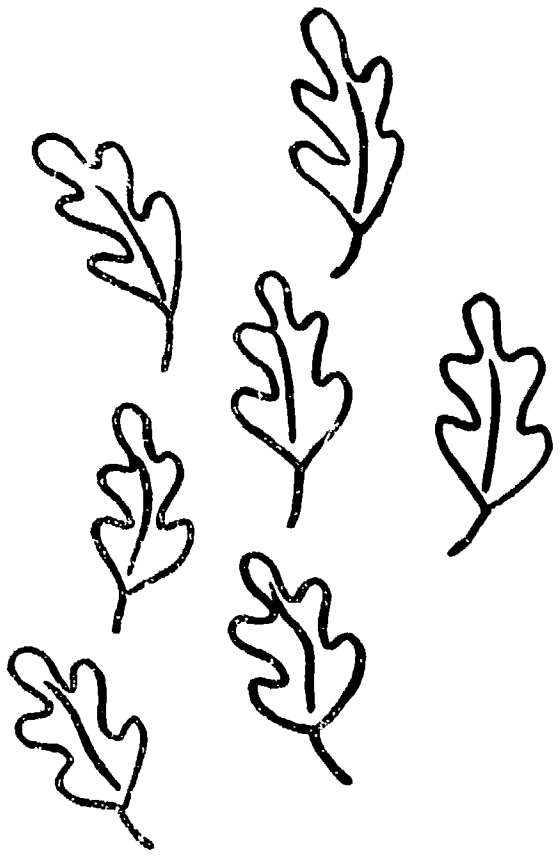




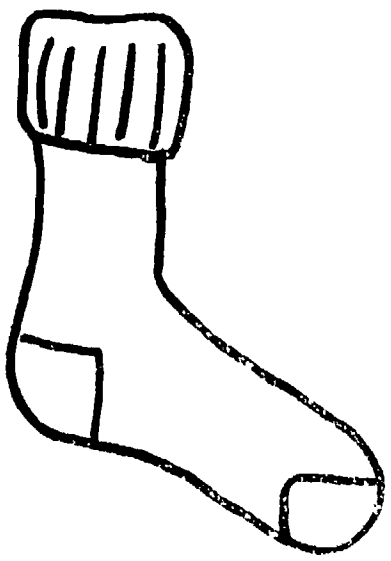
3

4

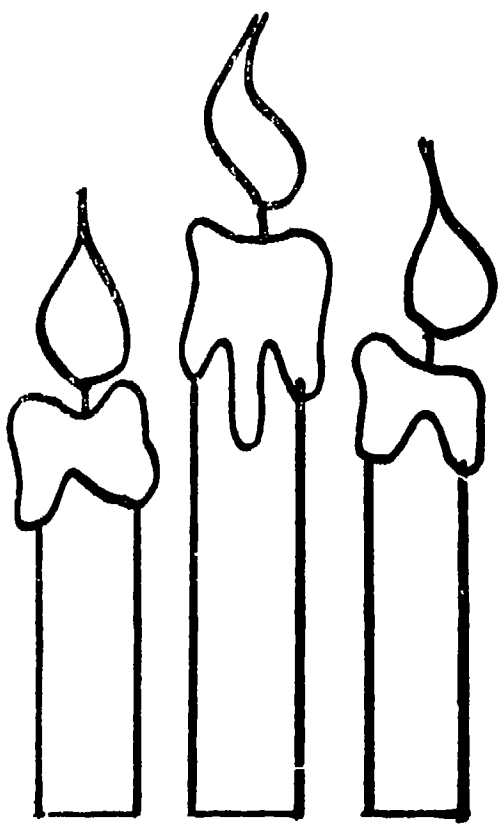
6



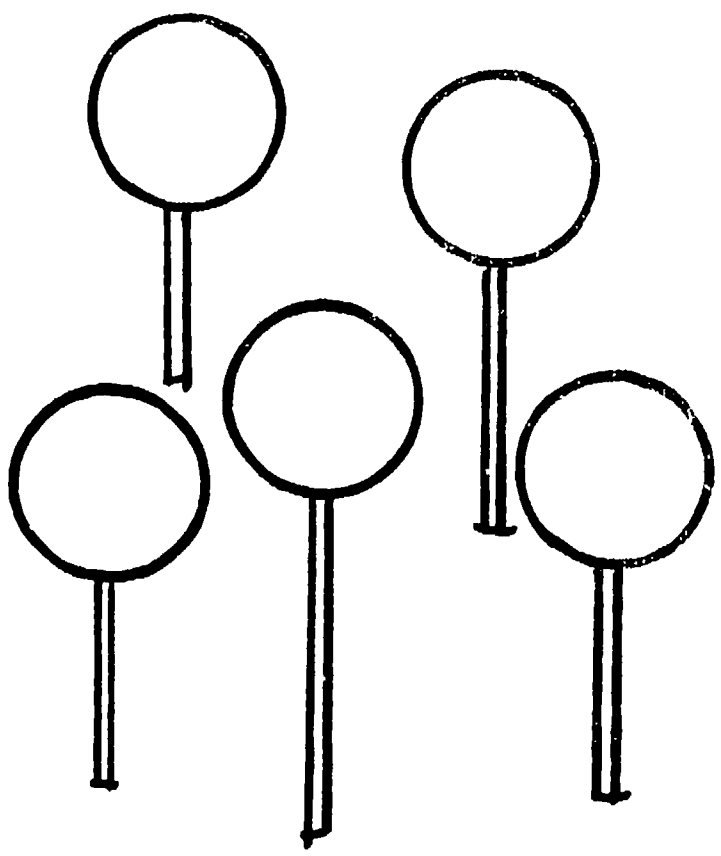
1



2



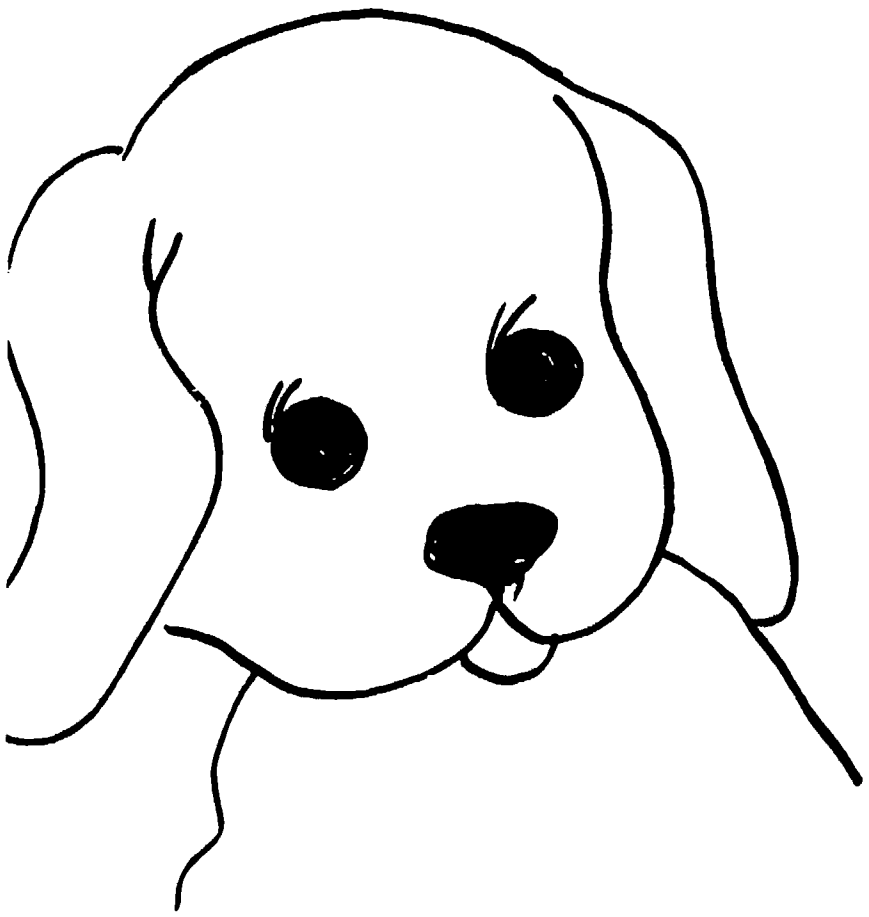
3



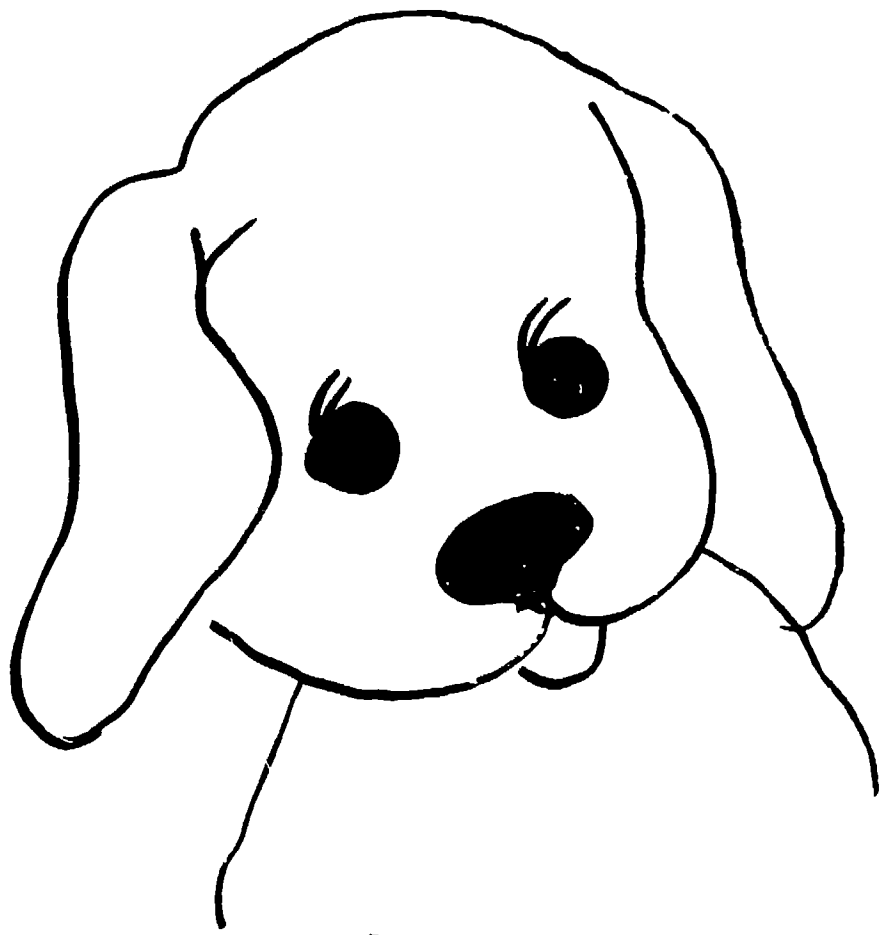
4

7

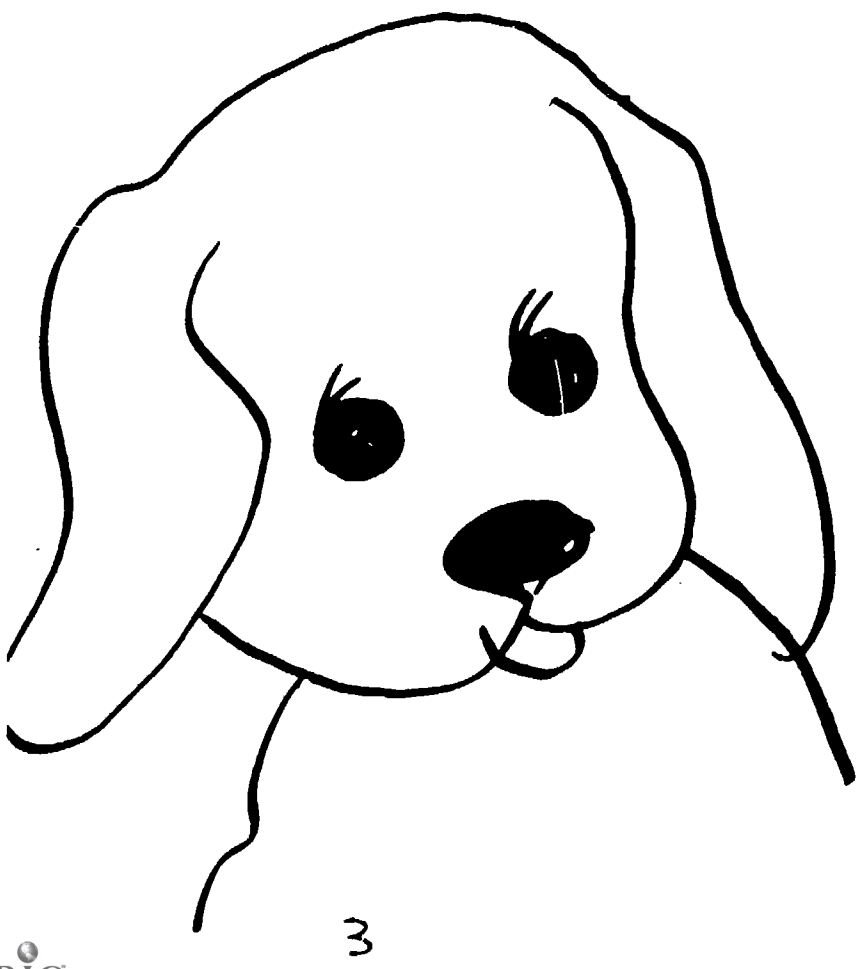
118



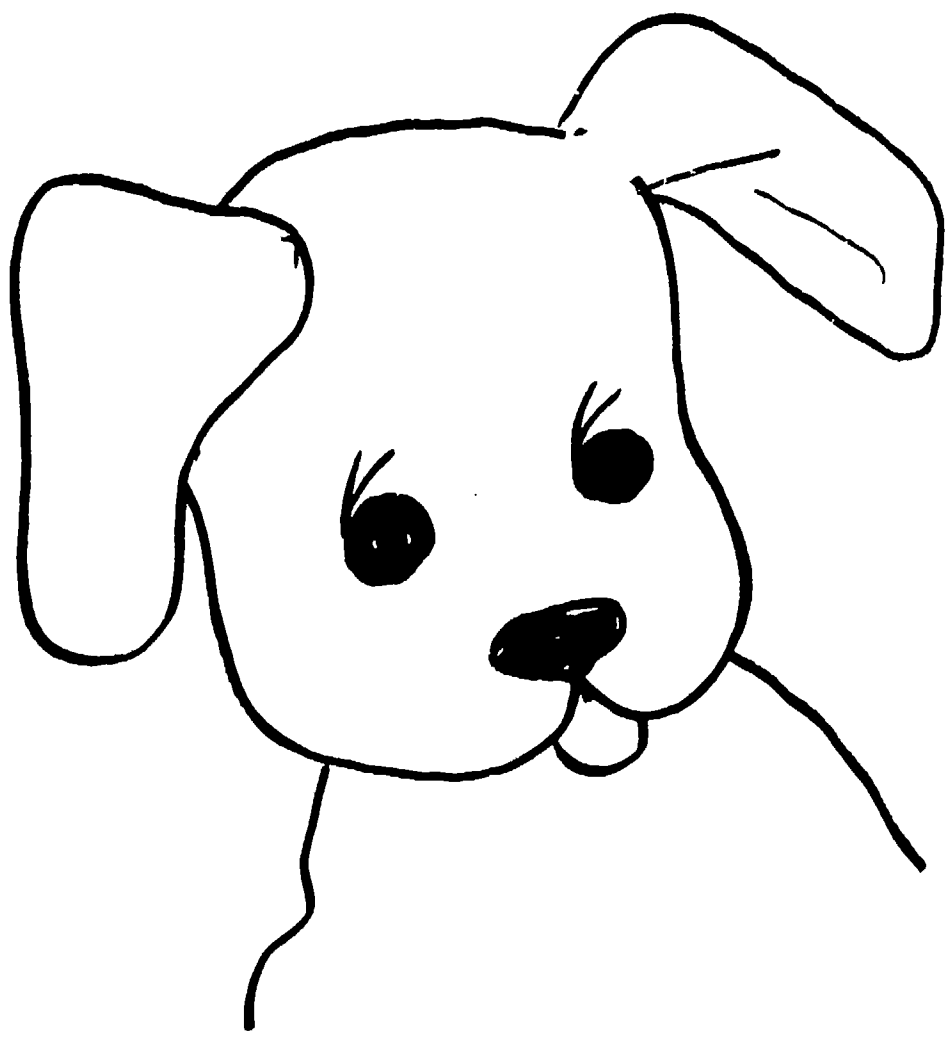
1



2



3



4

127

8

8

5

1

2

2

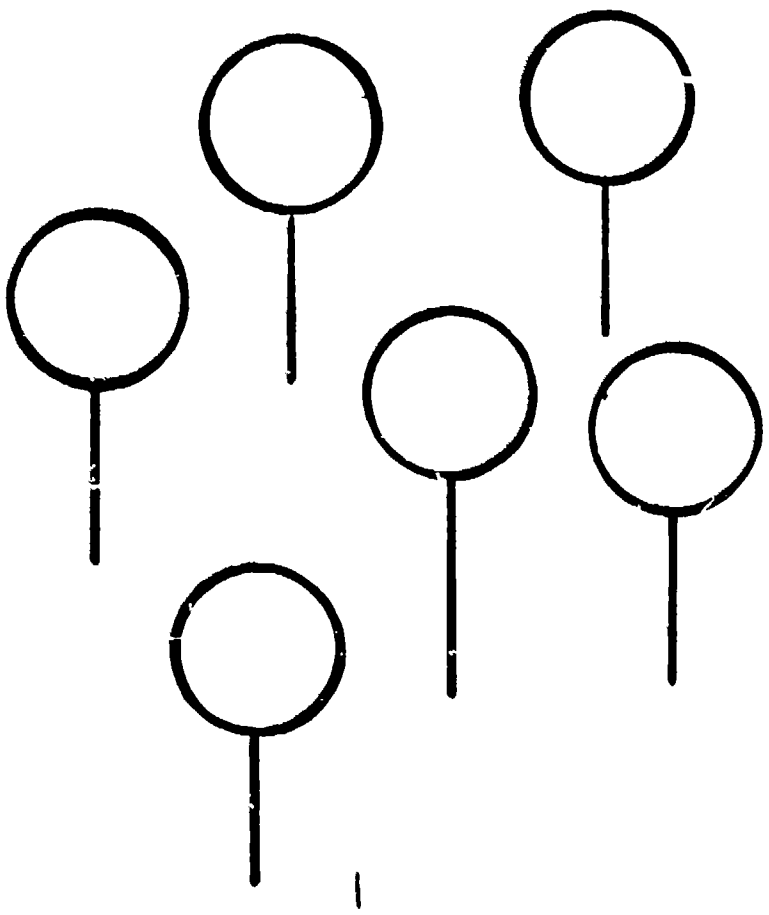
3

3

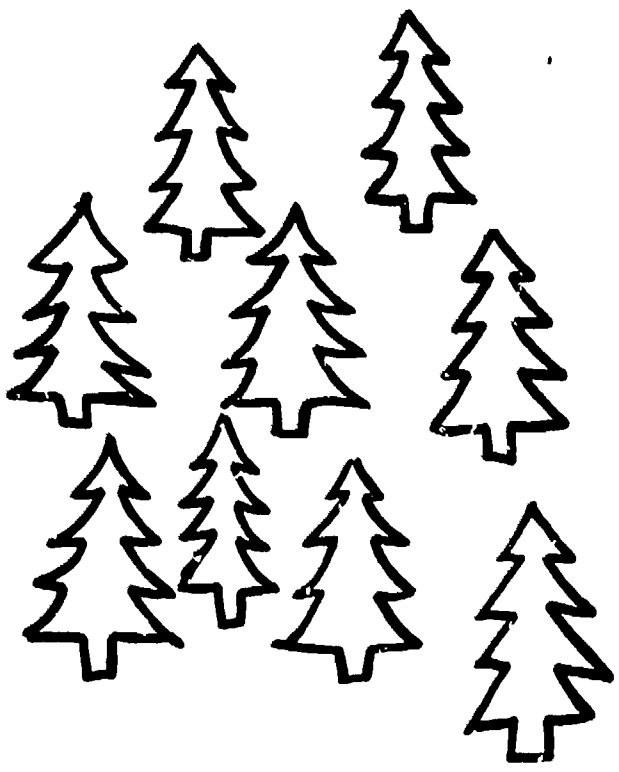
4

9

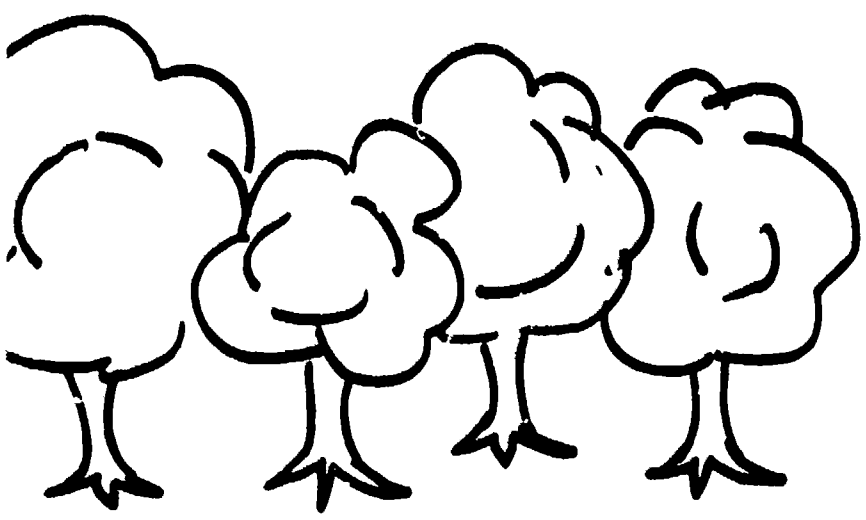
120



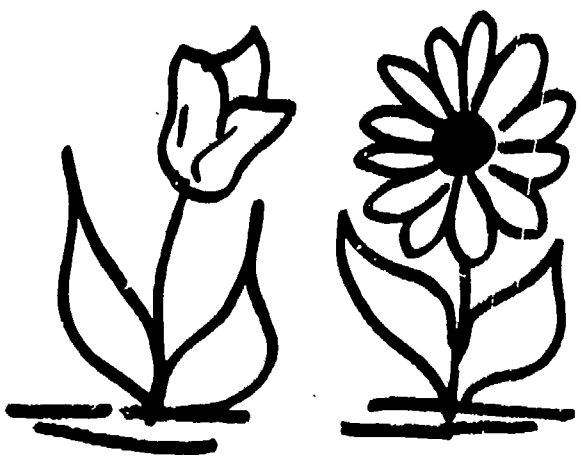
1



2

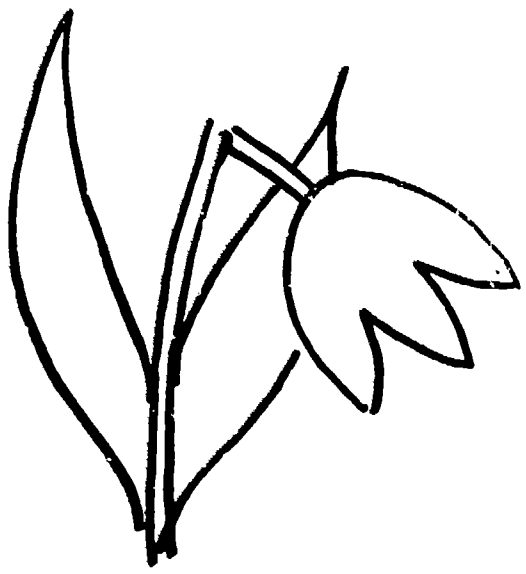


3

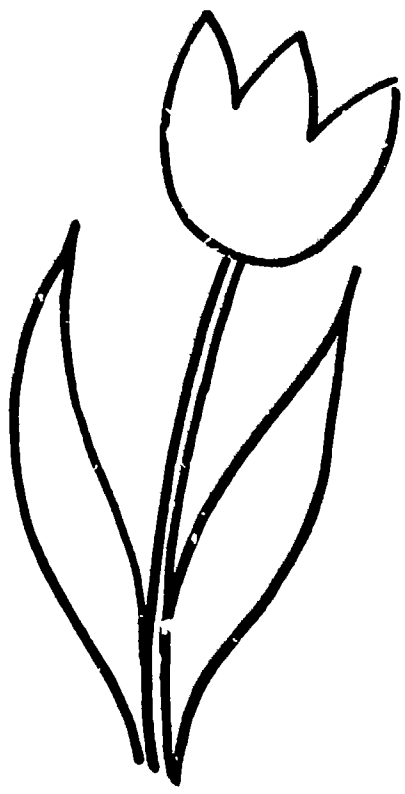


4

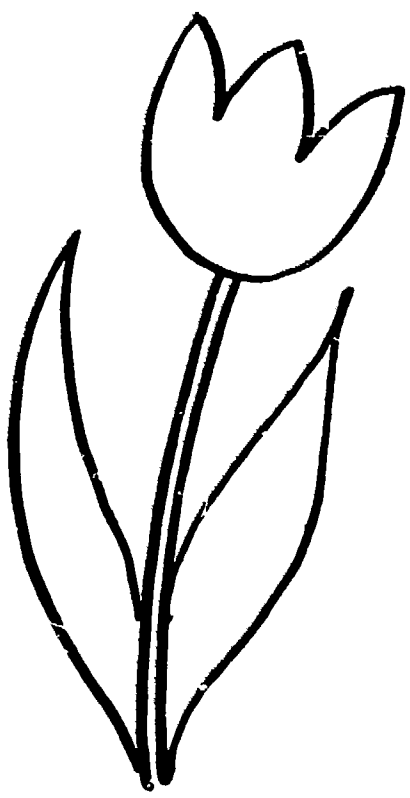
10



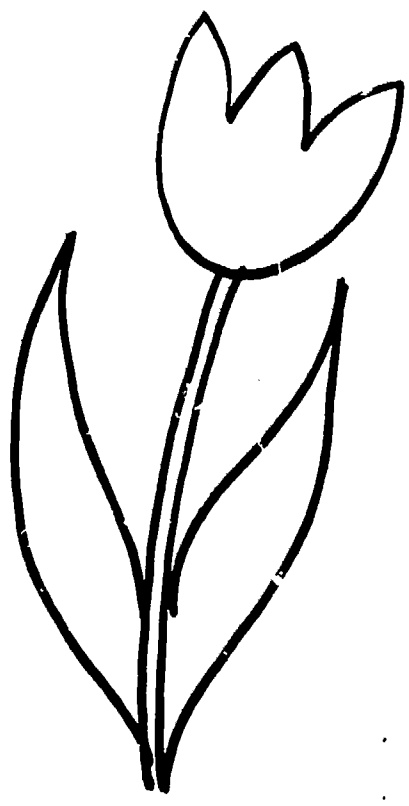
1



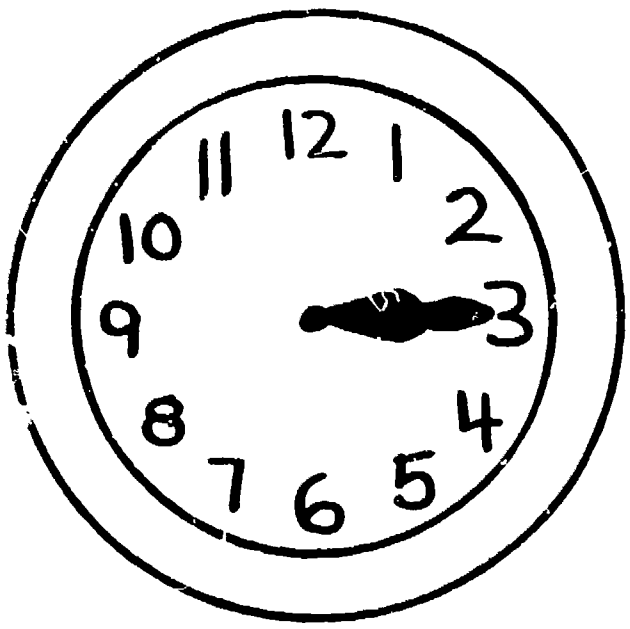
2



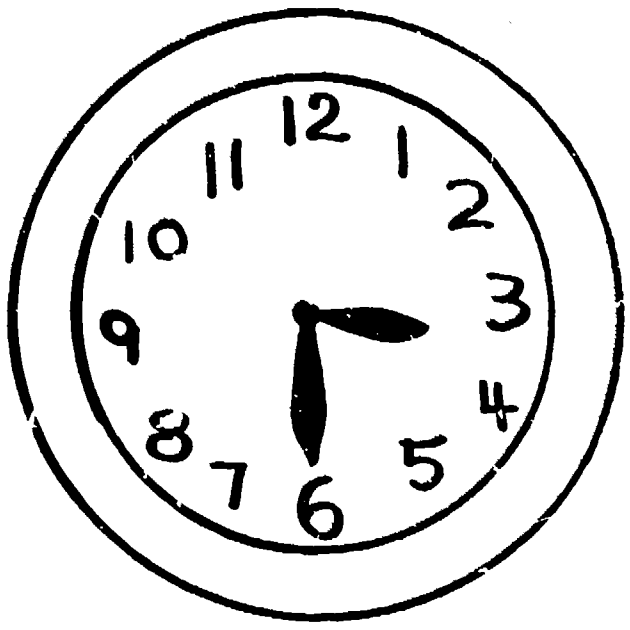
3



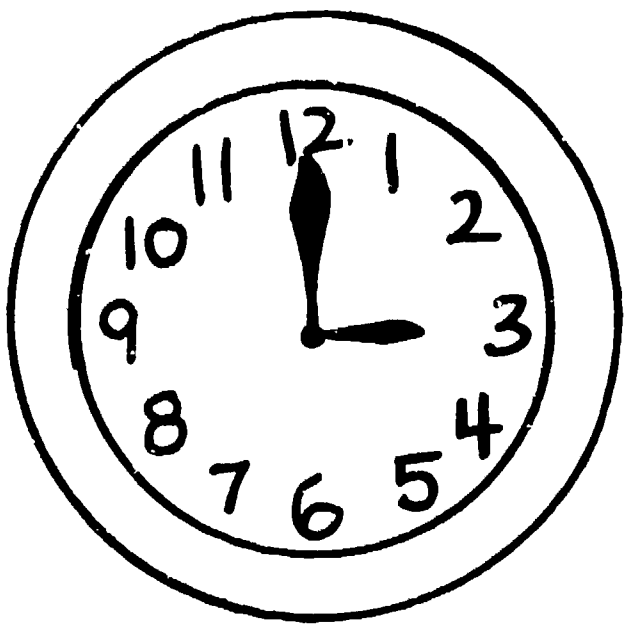
4


12
1
2
3
4
5
6
7
8
9
10
11

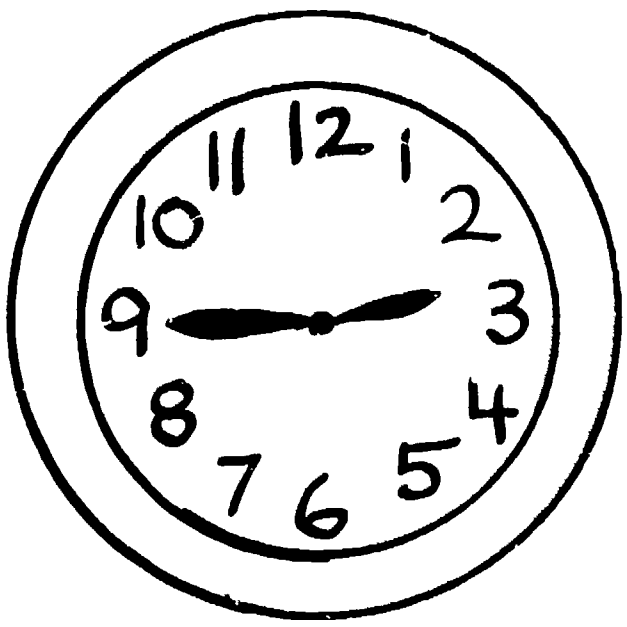
1


12
1
2
3
4
5
6
7
8
9
10
11

2


12
1
2
3
4
5
6
7
8
9
10
11

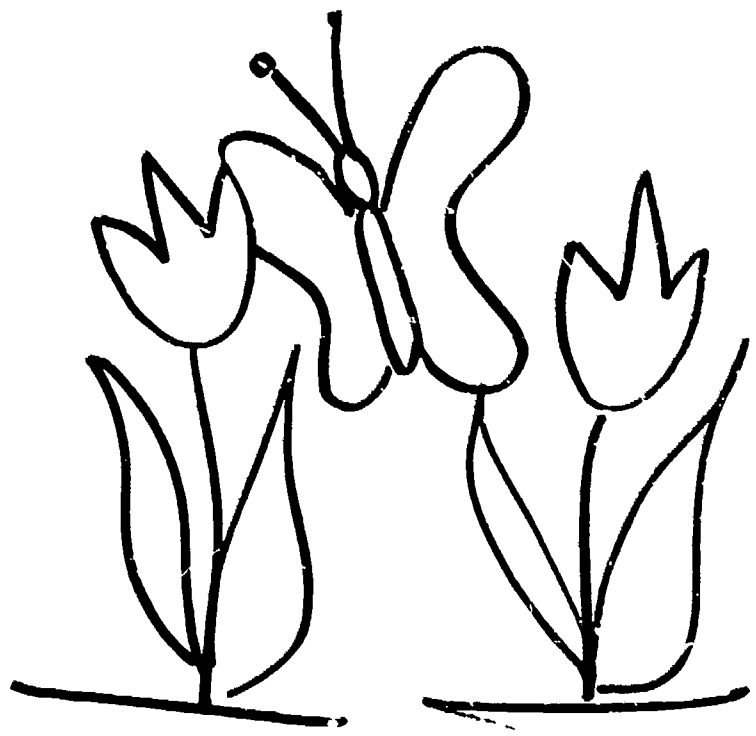
3


12
1
2
3
4
5
6
7
8
9
10
11

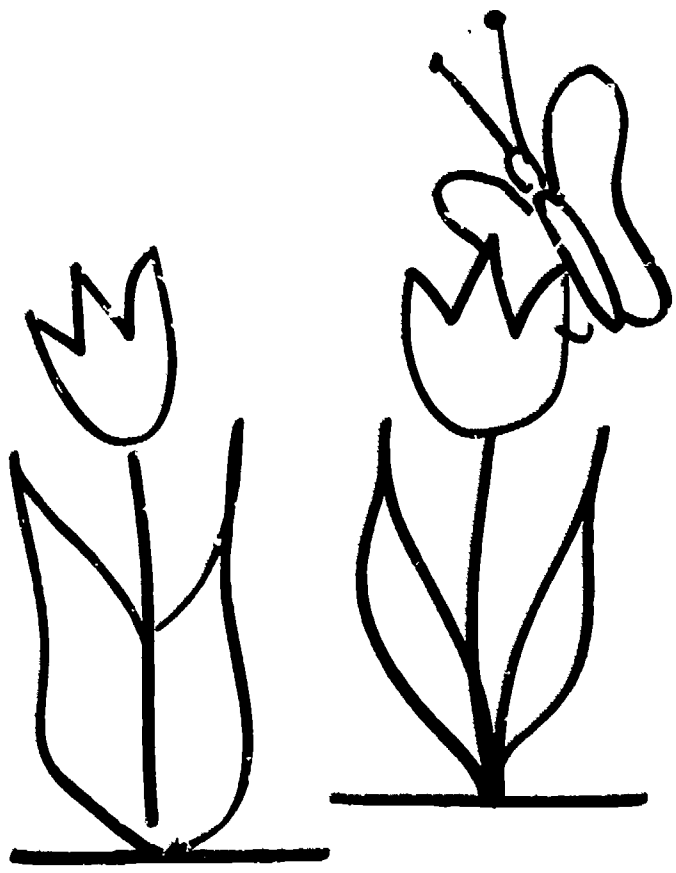
4

12

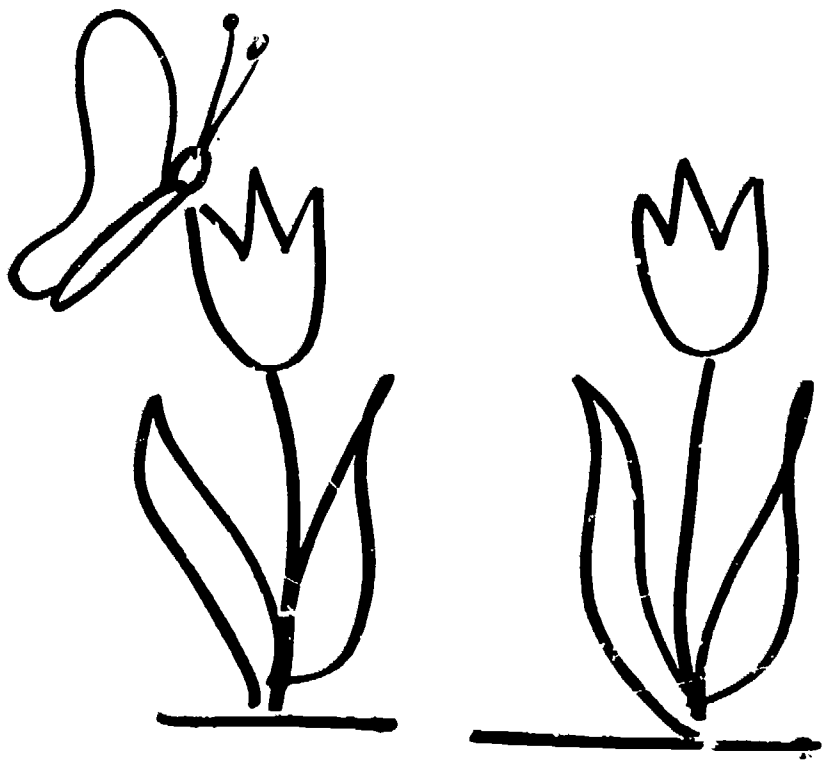
1



2



3



4

13

124

9

12

1

2

13

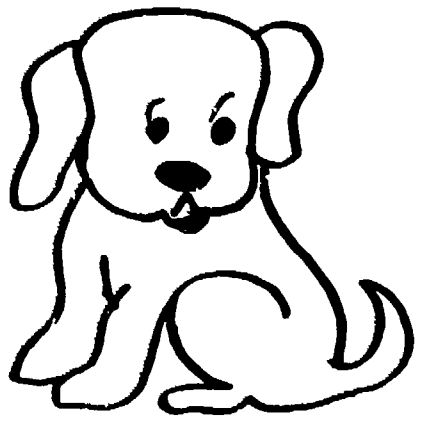
10

3

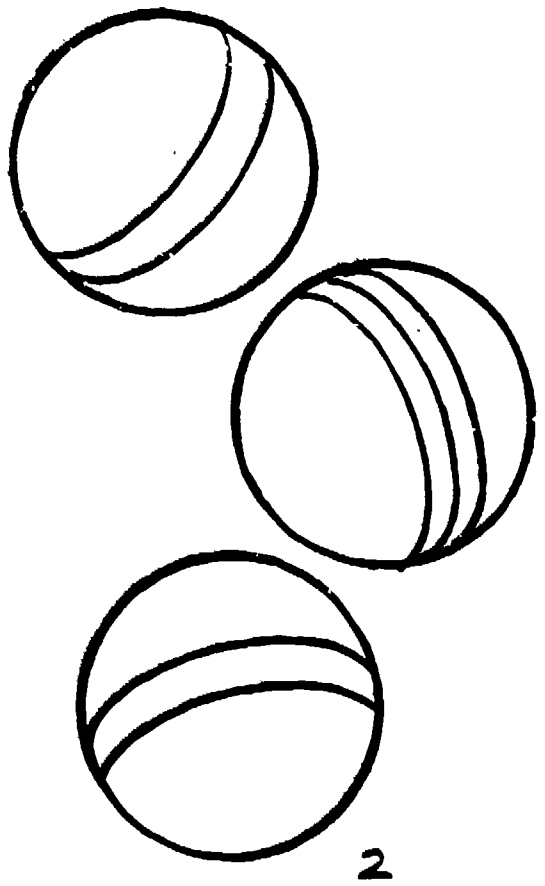
4

133

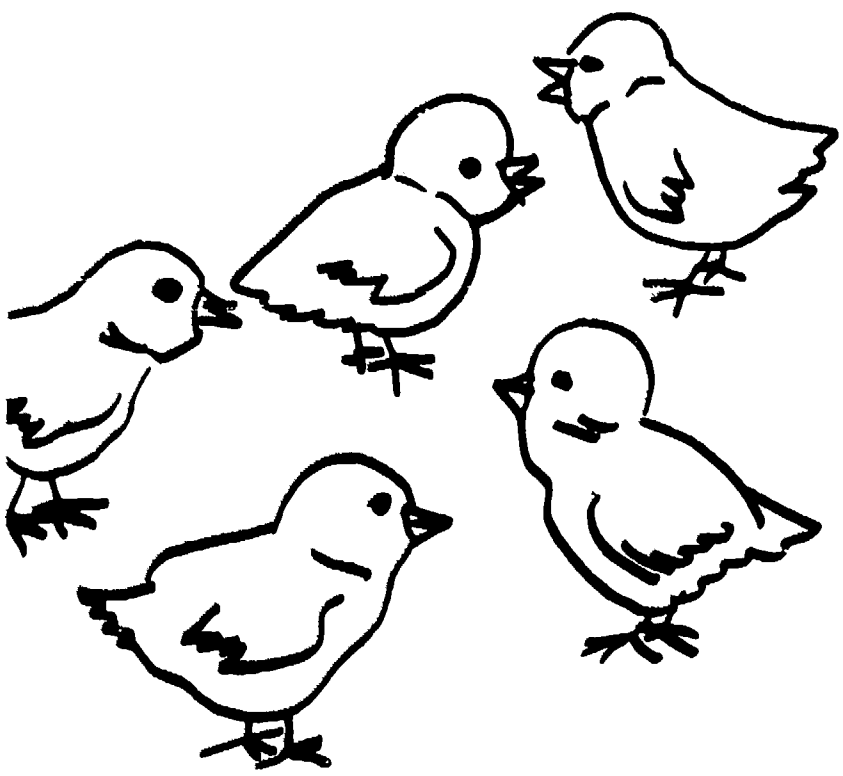
14



1



2

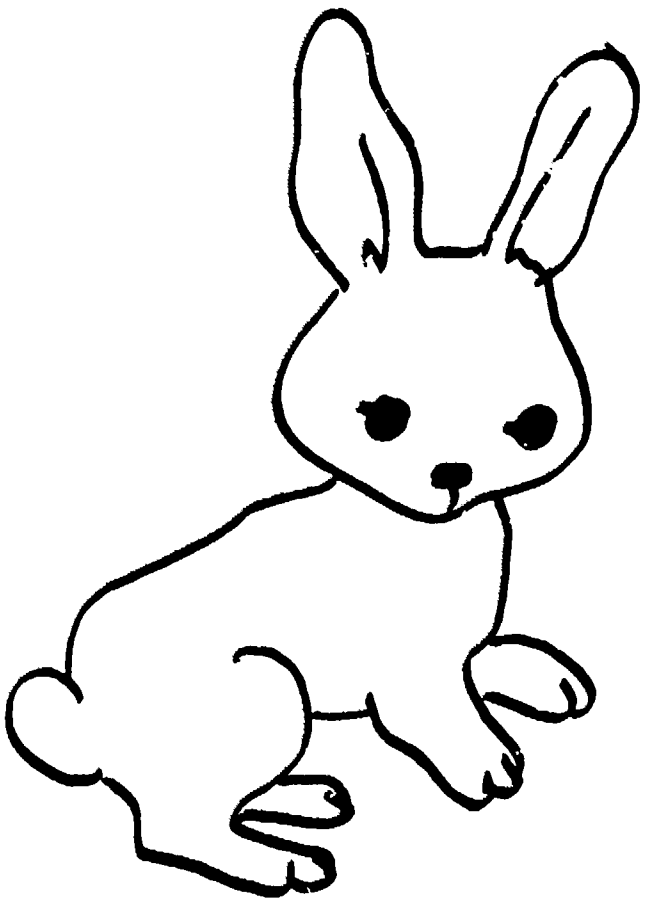


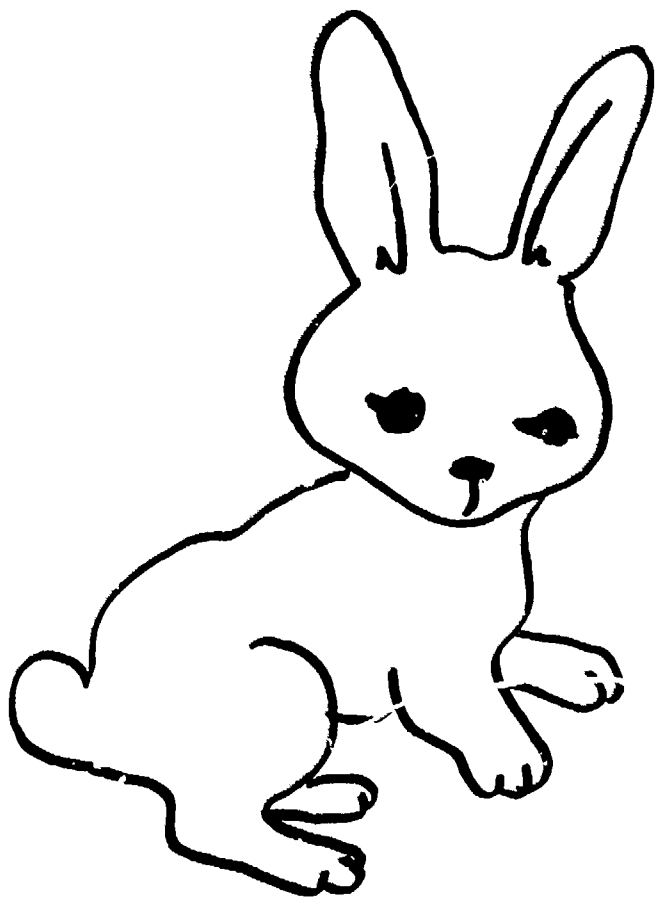
3

4

15

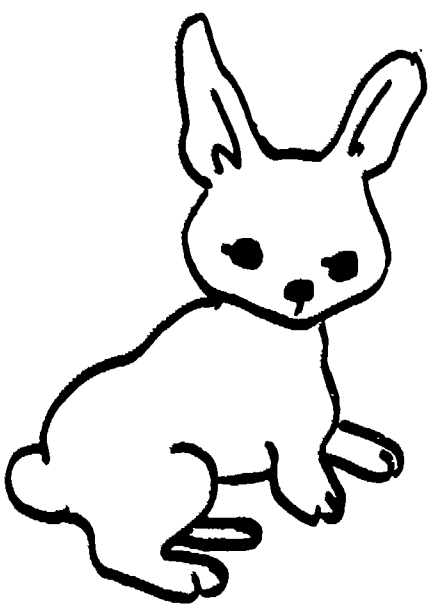
126



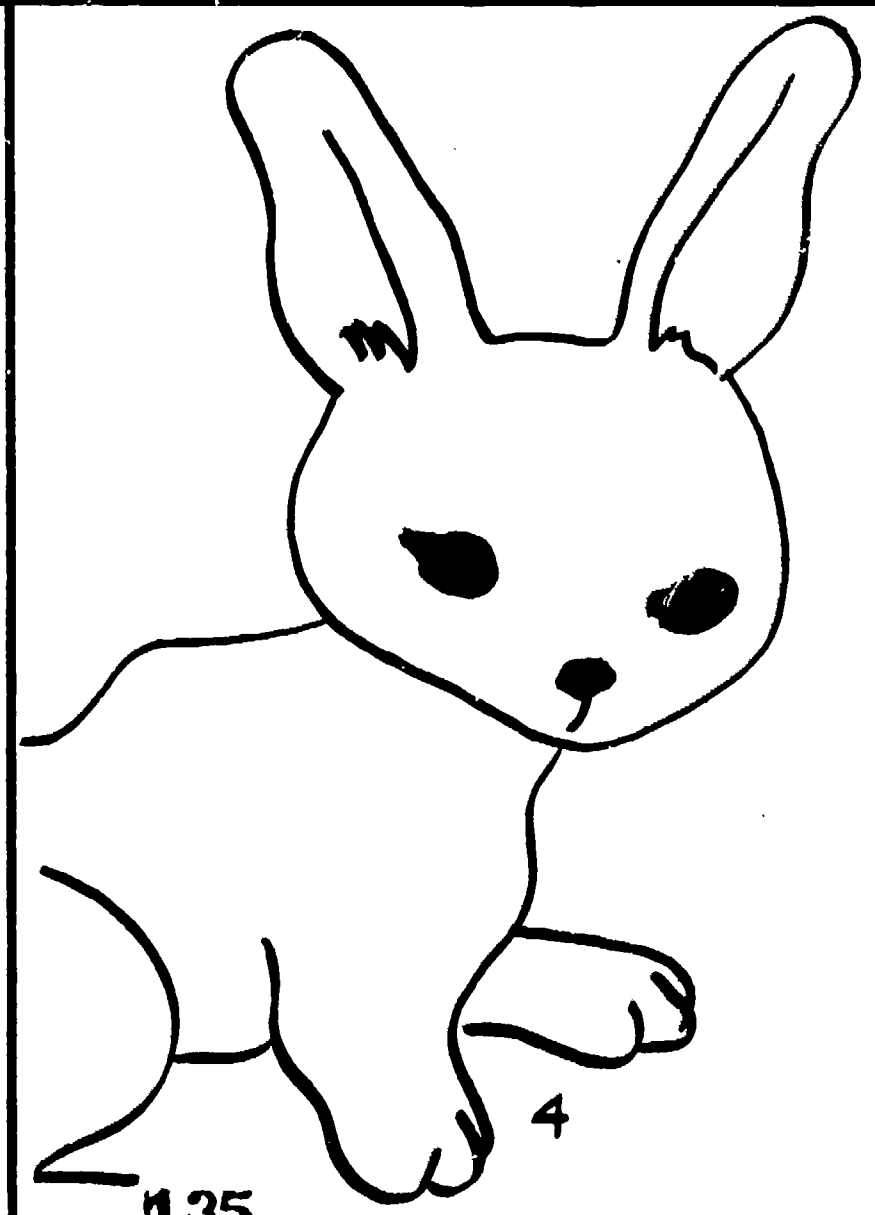


1

2



3

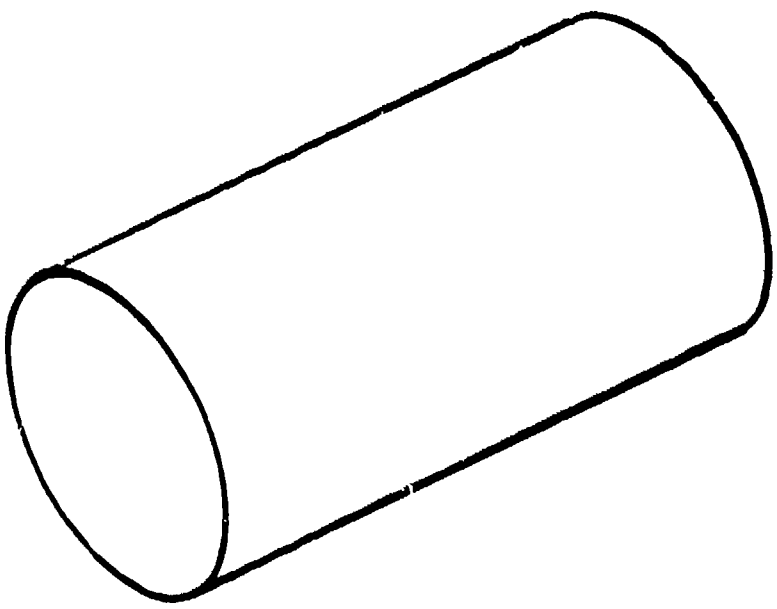


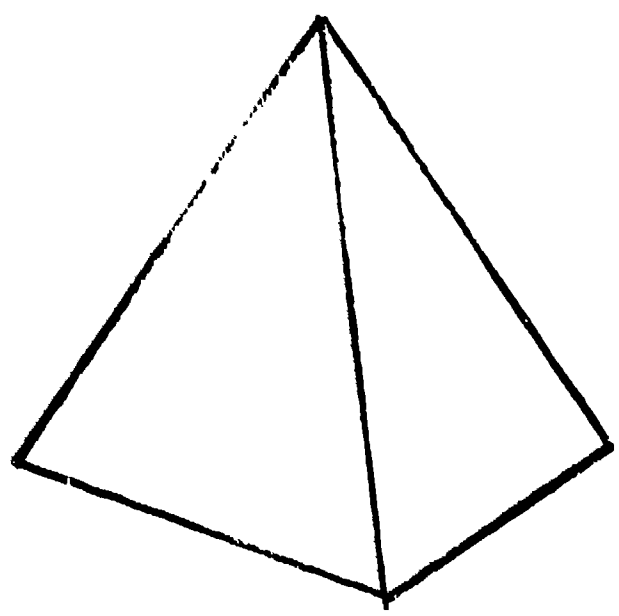
4

135

16

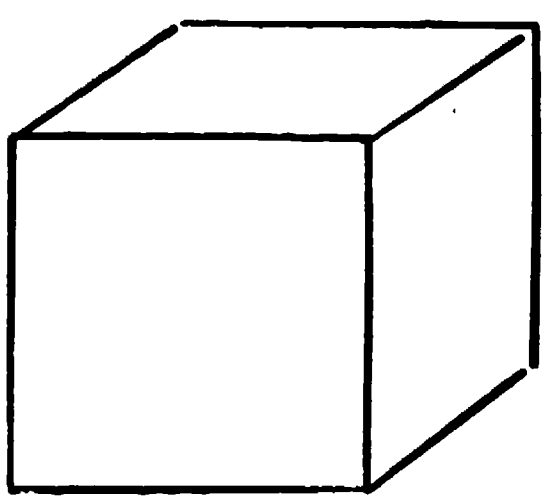
127

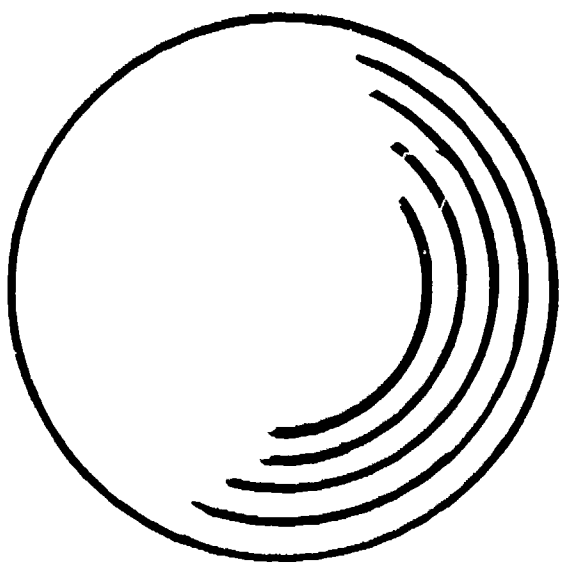




1

2





3

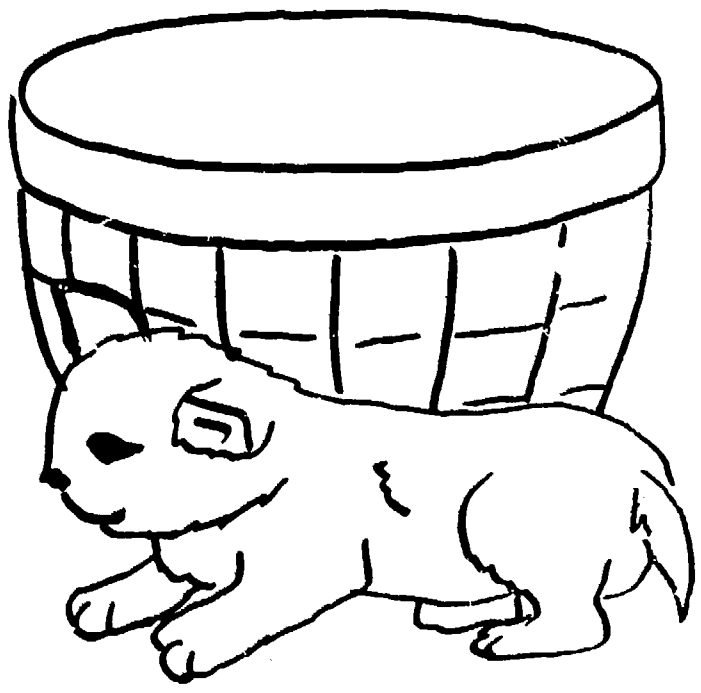
136

4

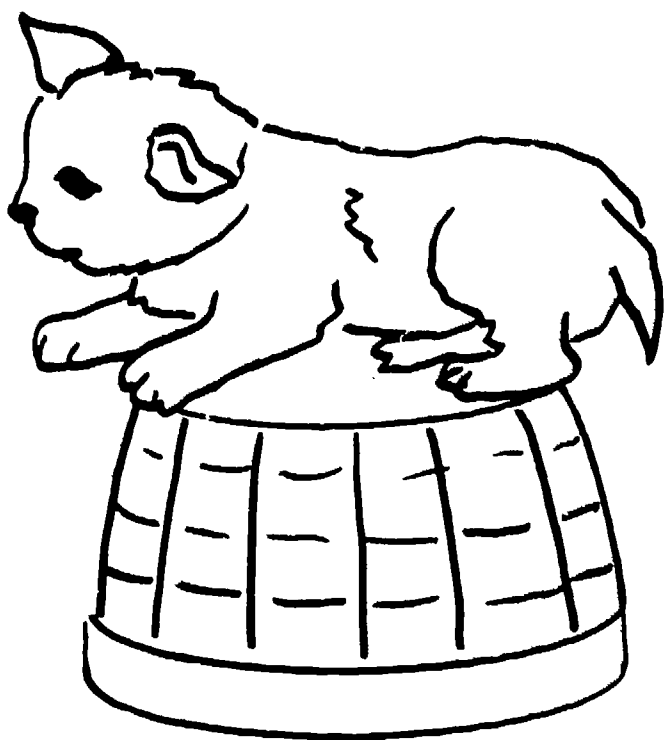
17

128

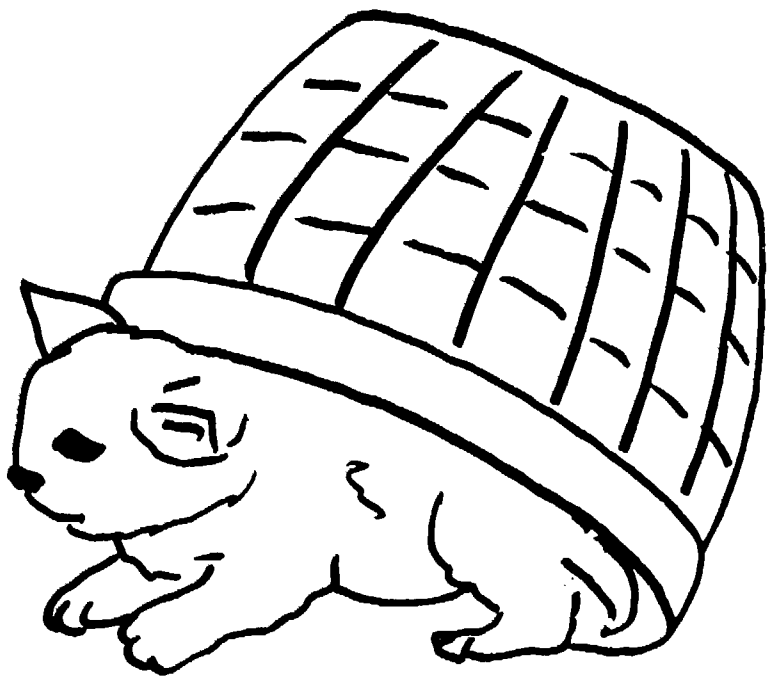
1



2



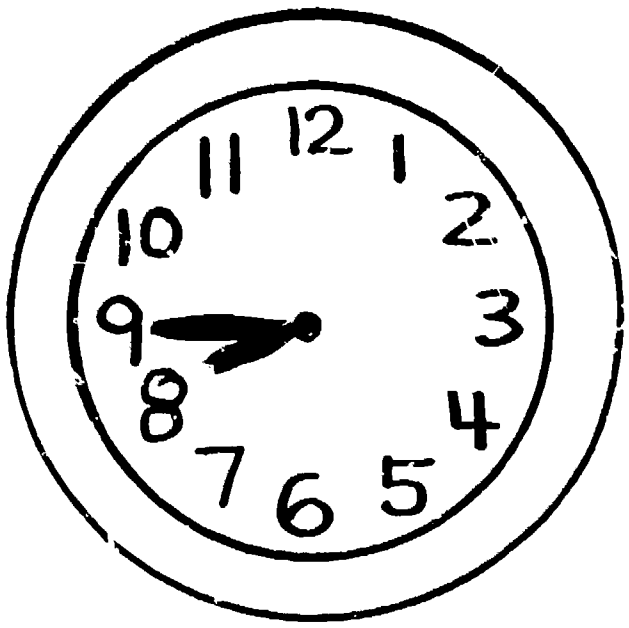
3



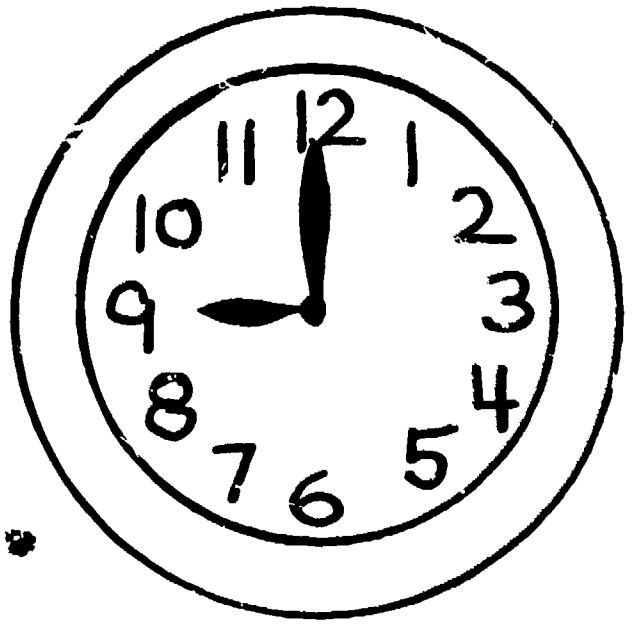
4

137

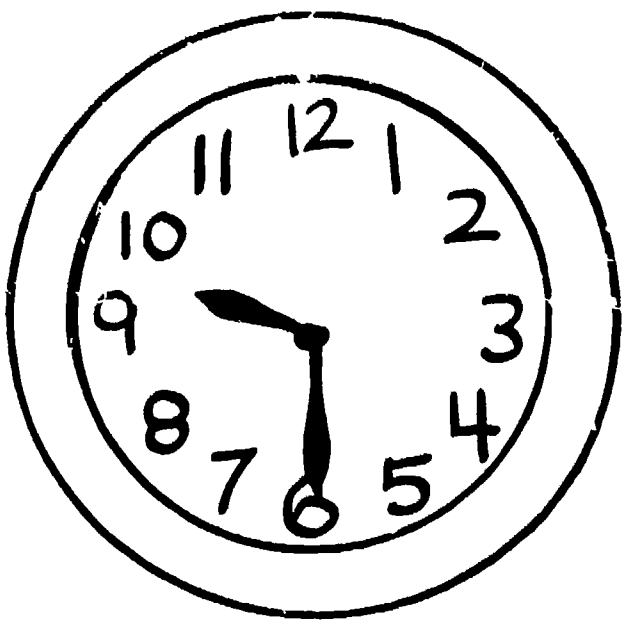
18


12
1
2
3
4
5
6
7
8
9
10
11

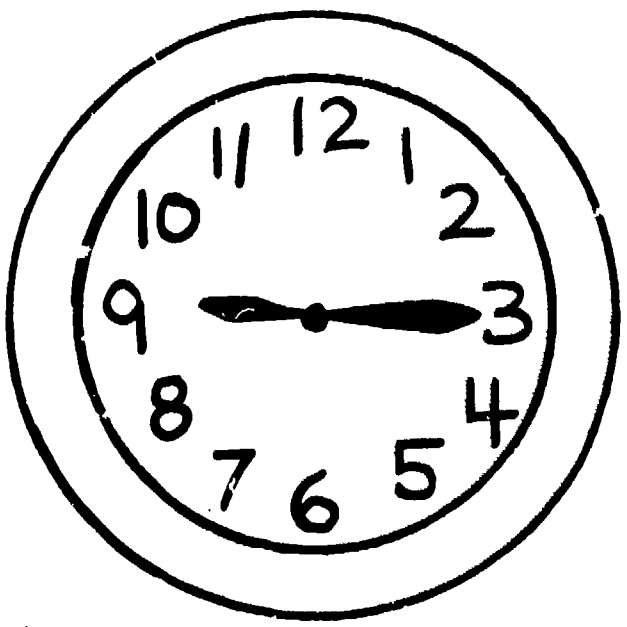
1


12
1
2
3
4
5
6
7
8
9
10
11

2


12
1
2
3
4
5
6
7
8
9
10
11

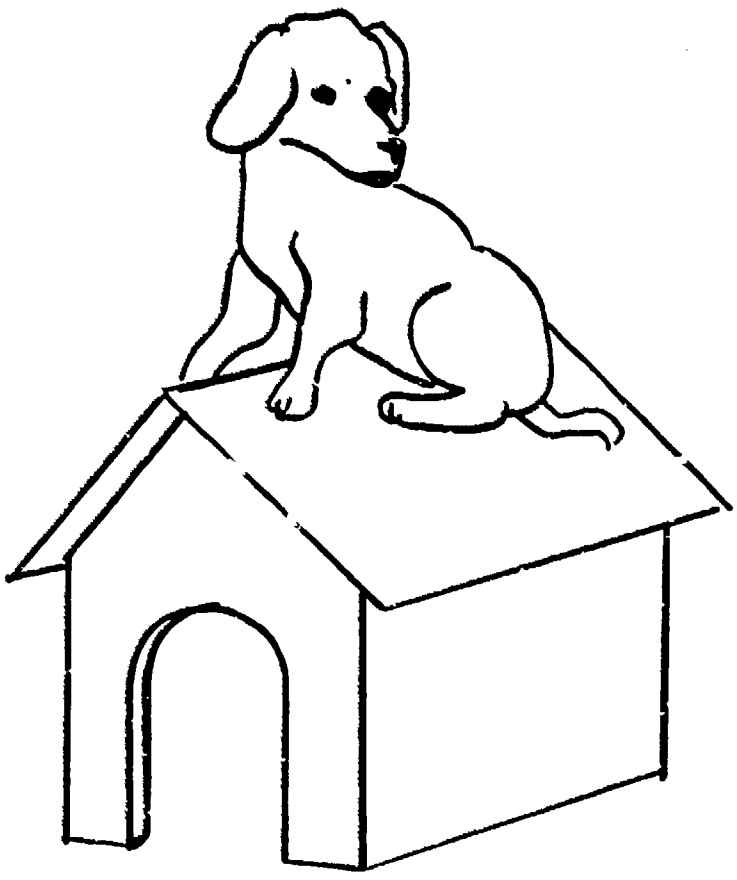
3


12
1
2
3
4
5
6
7
8
9
10
11

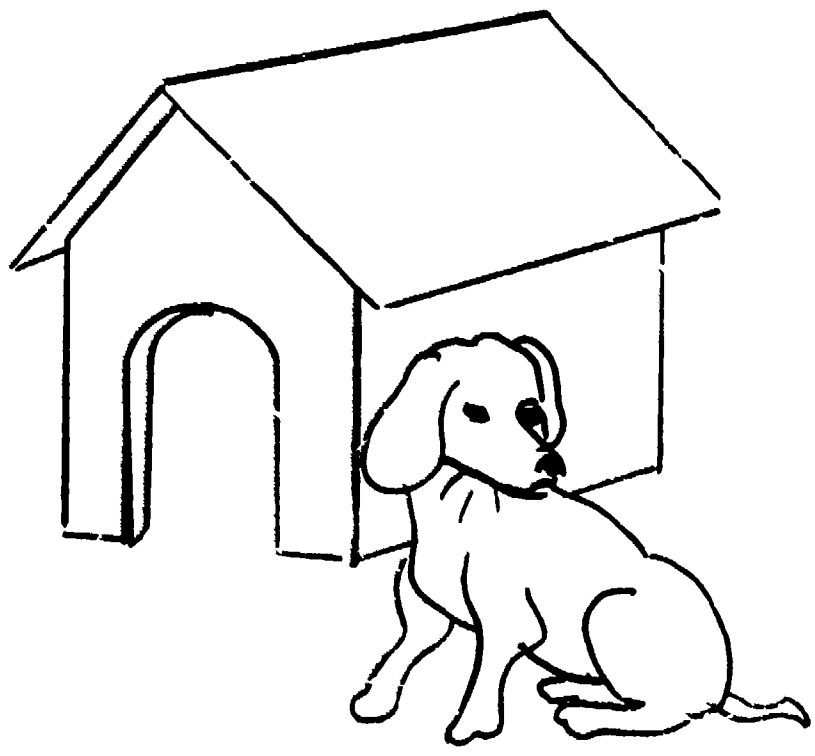
4

19

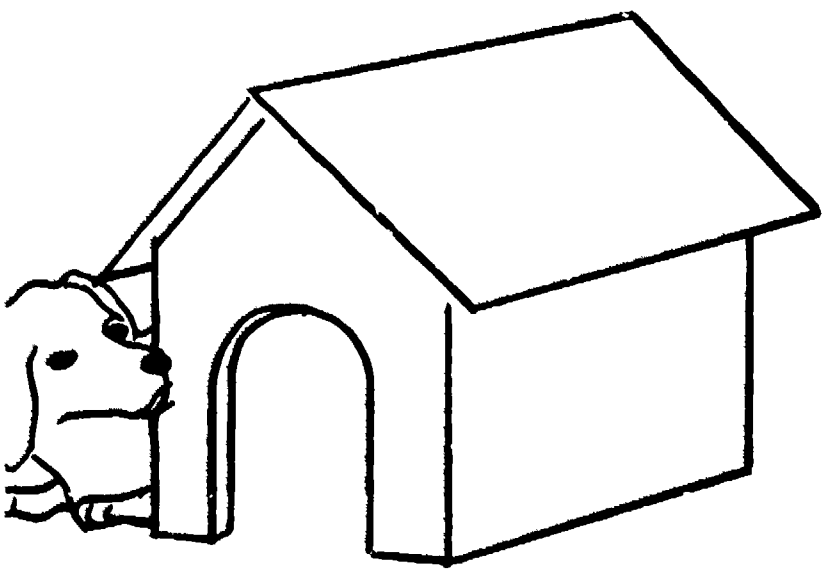
130



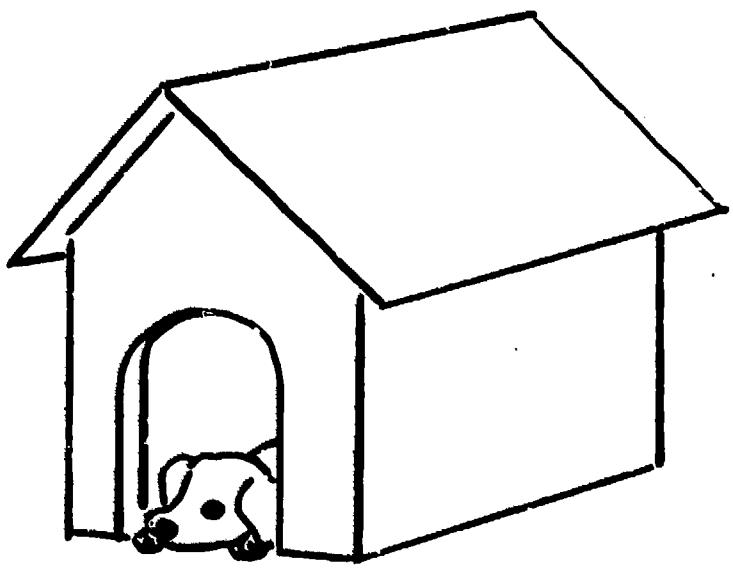
1



2



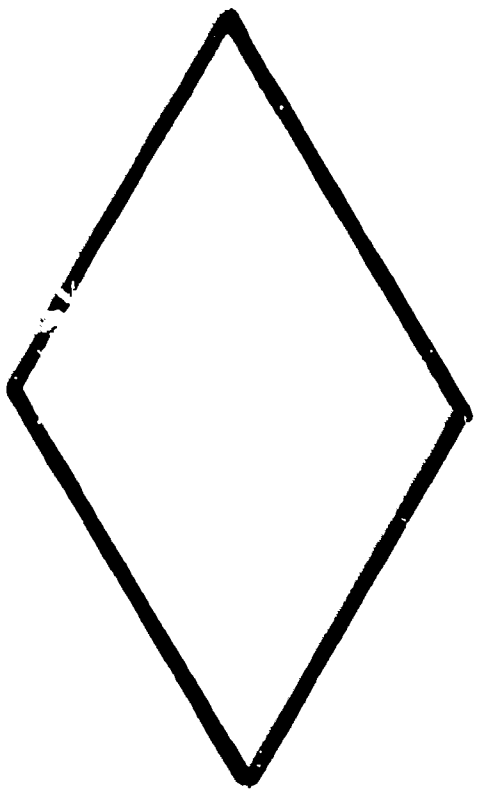
3

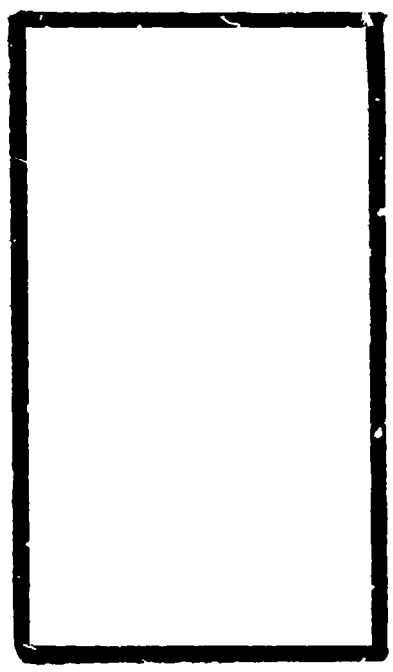


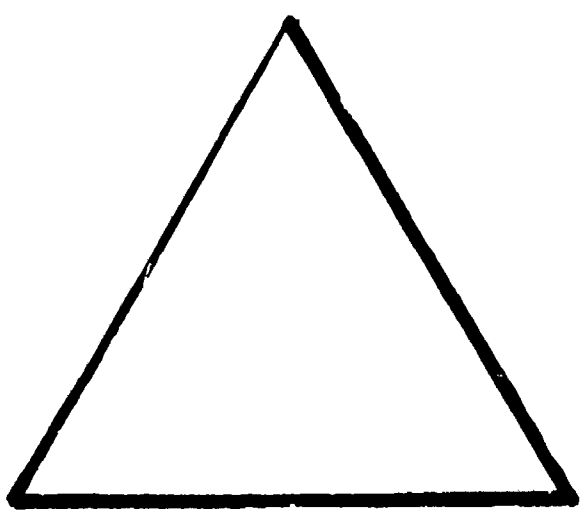
4

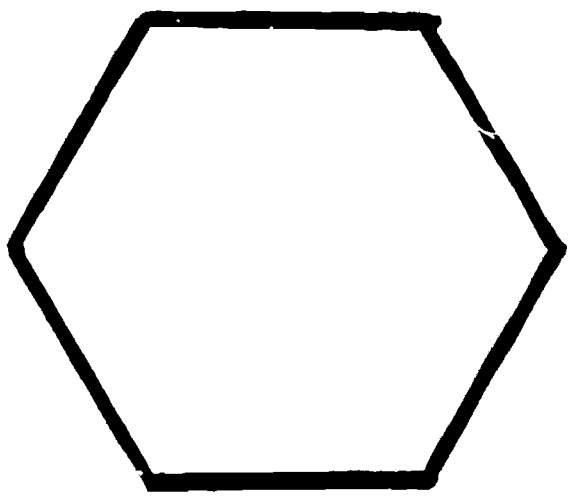
20

131

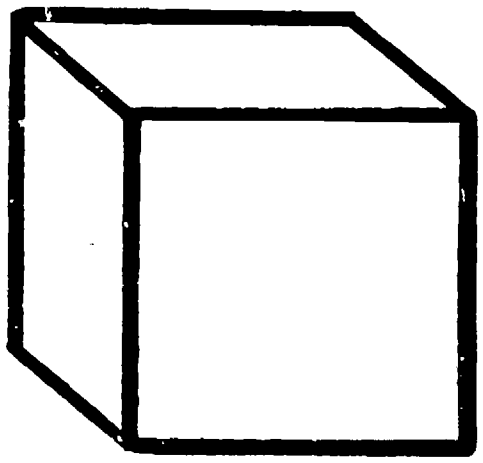


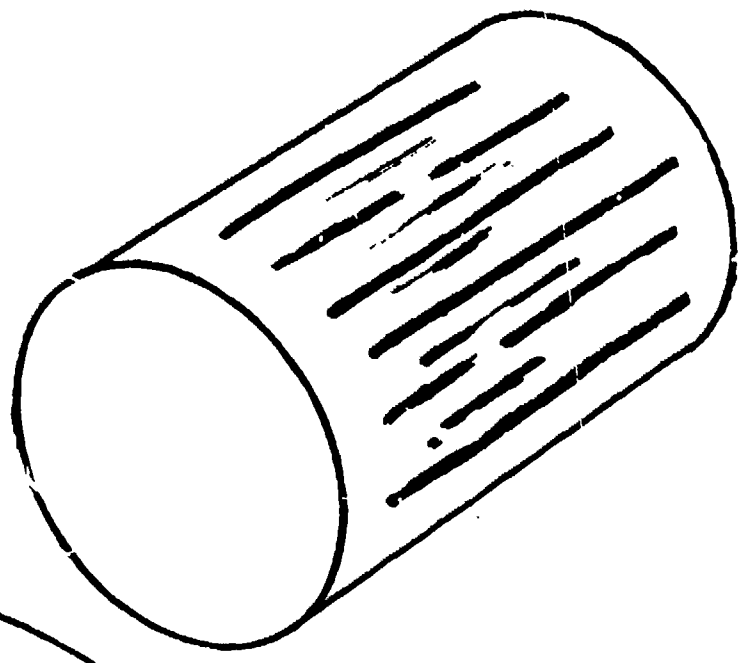


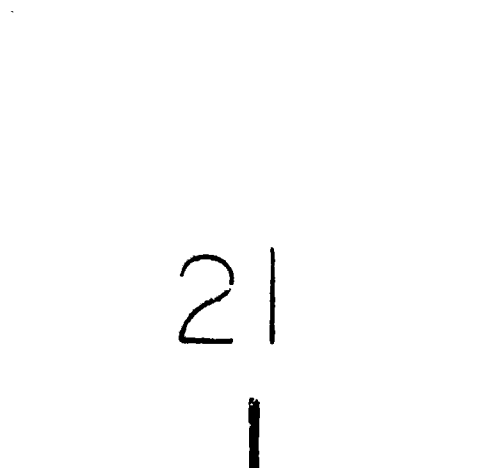




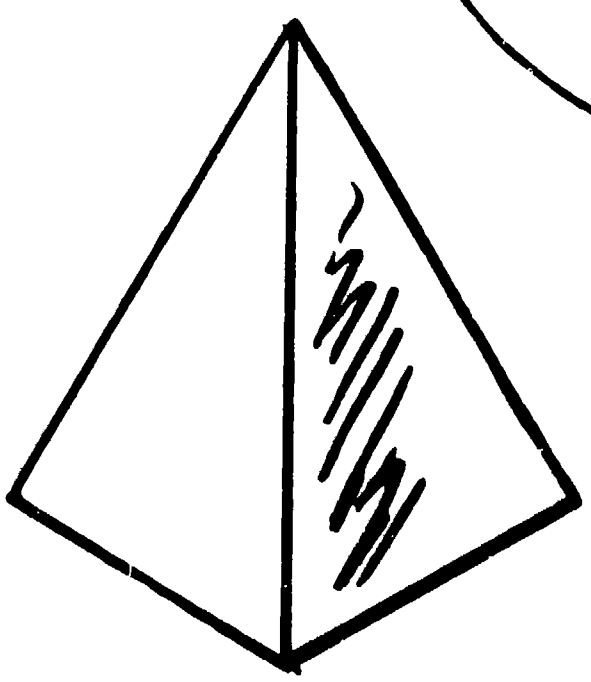
21

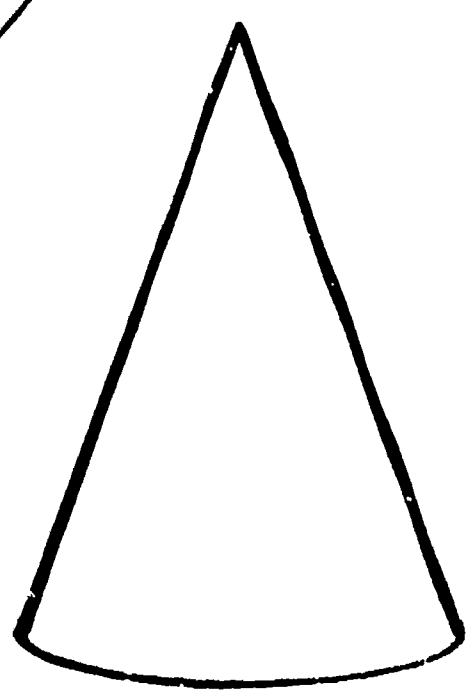






2

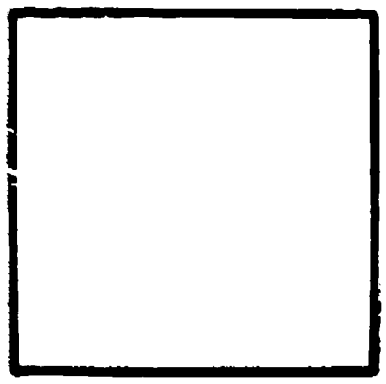


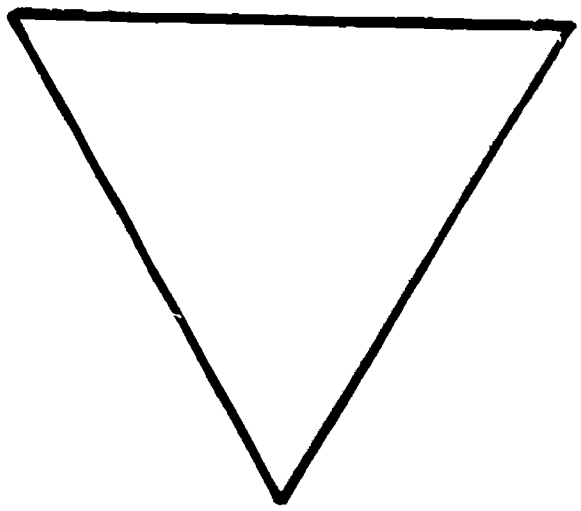


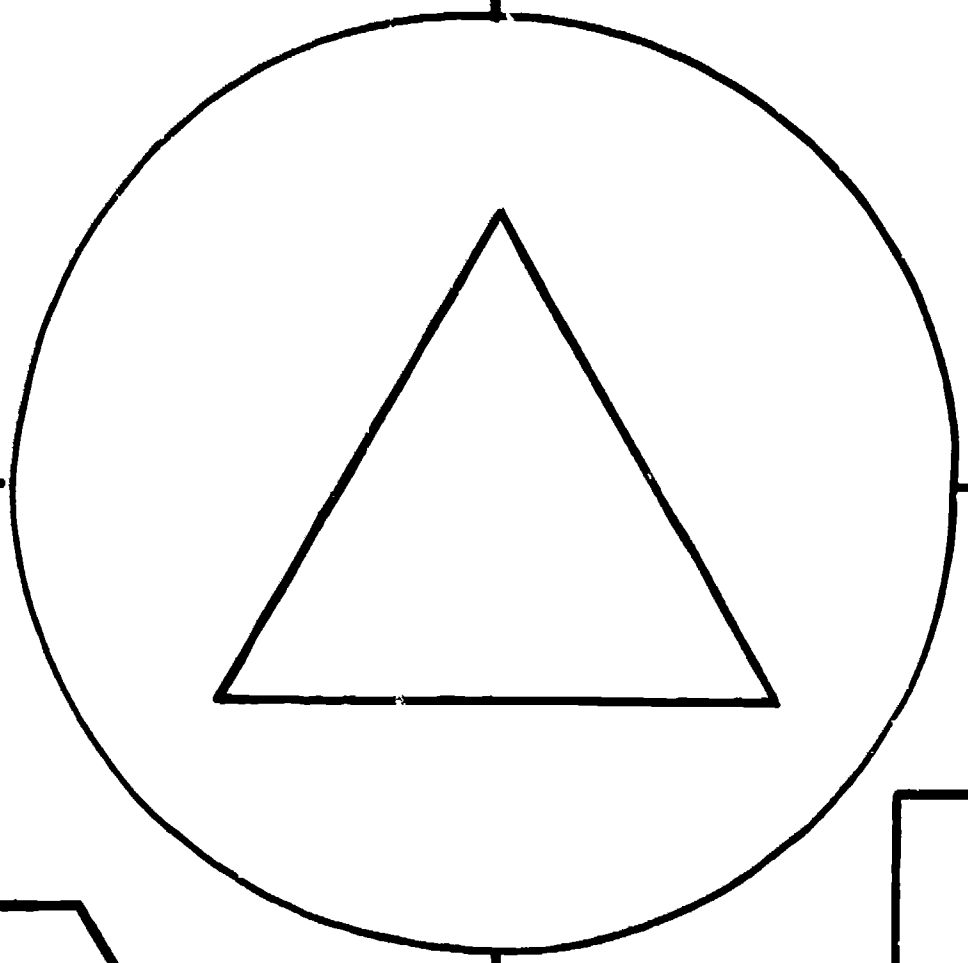
3

4

22

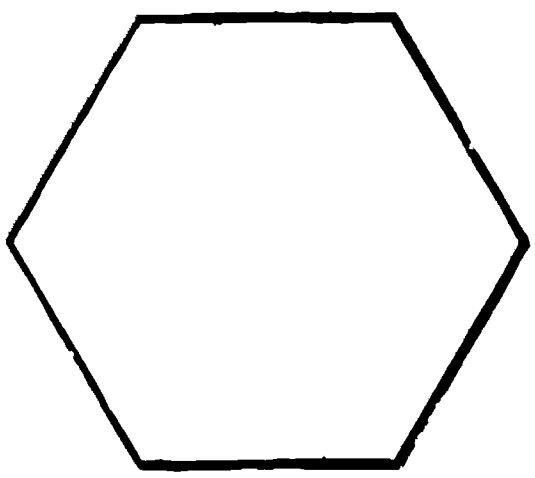


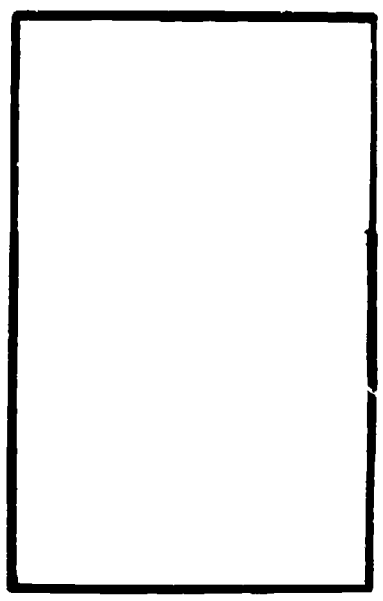




1

2



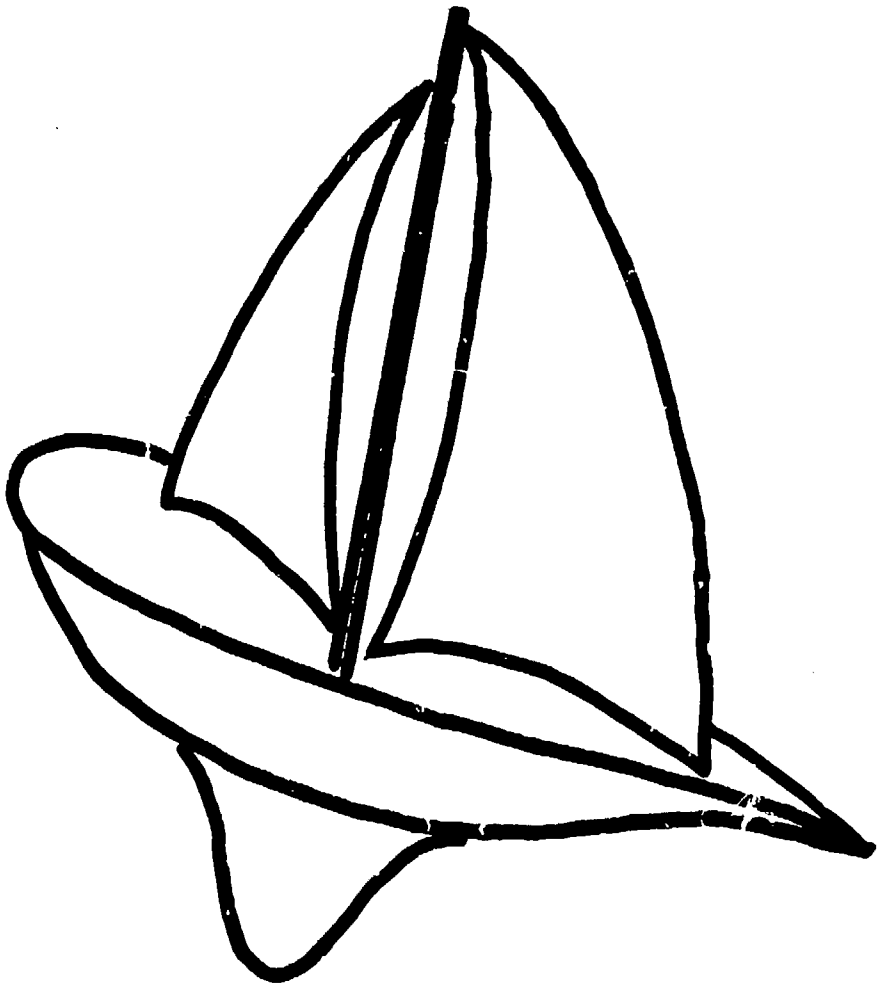


3

4

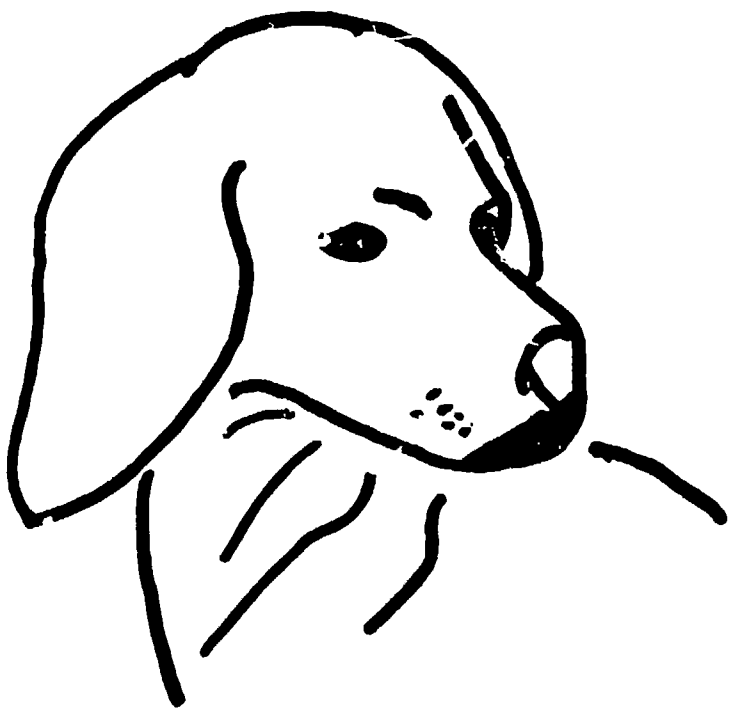
EXAMPLE B

1

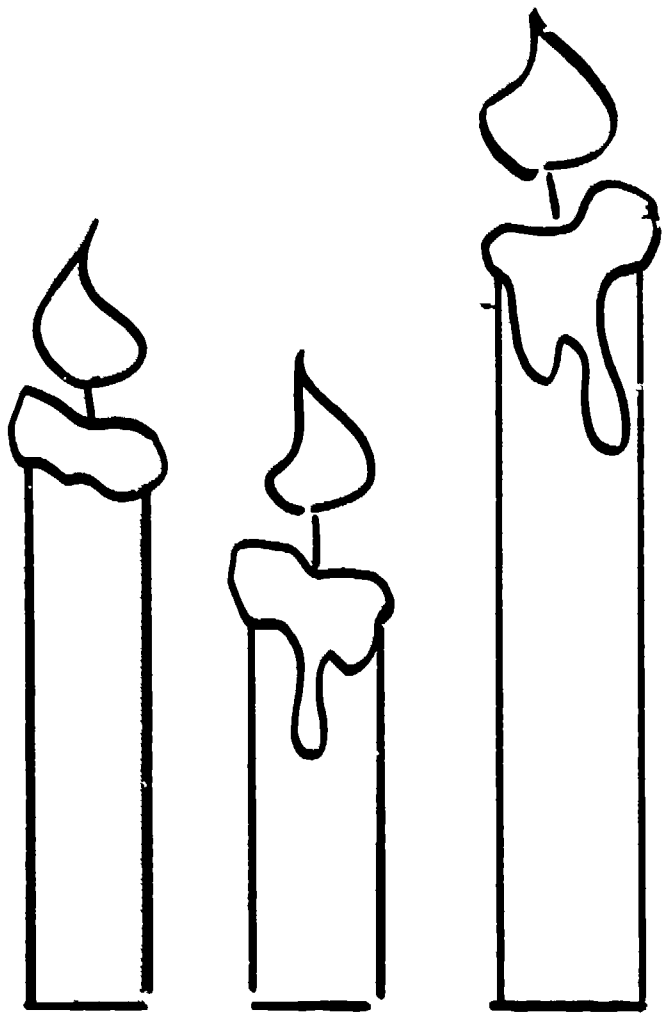


2

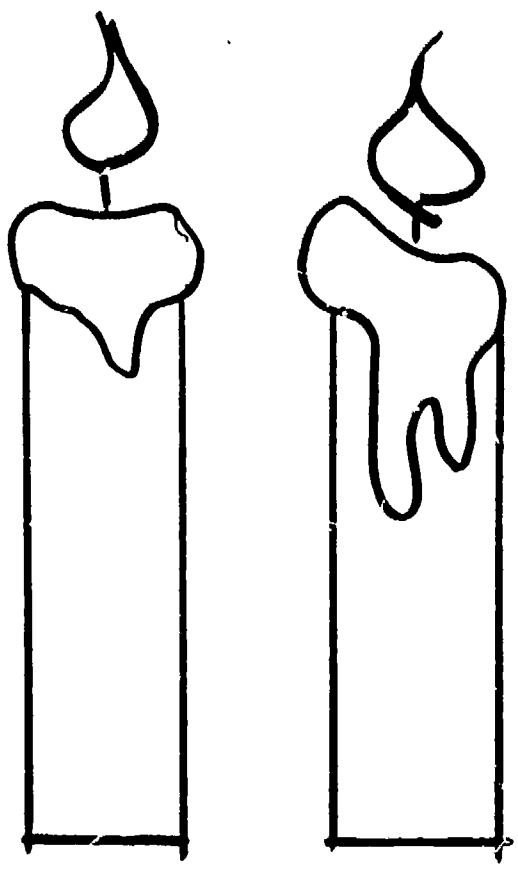
3



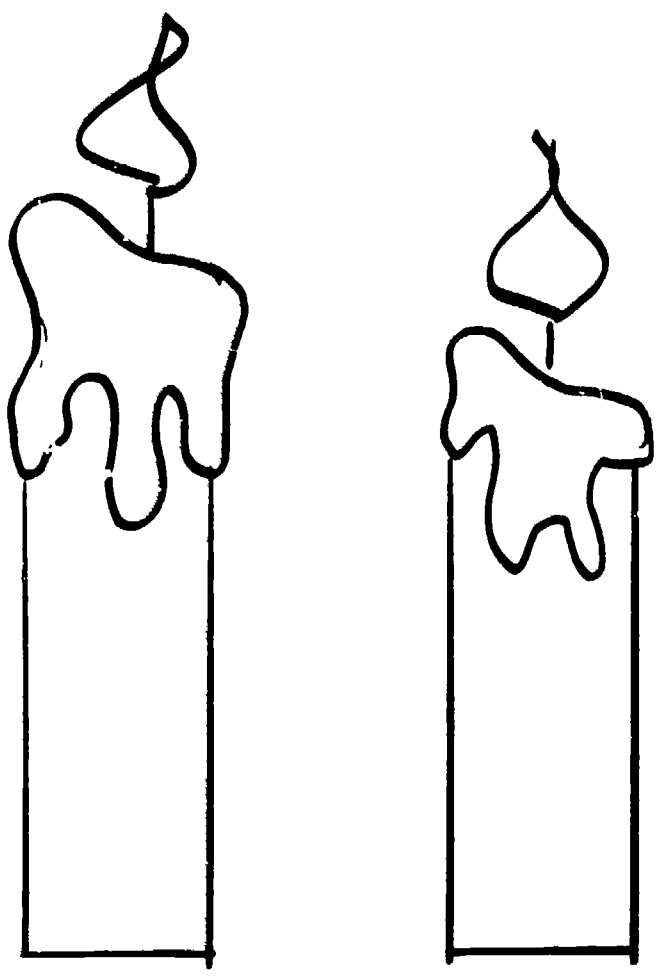
4



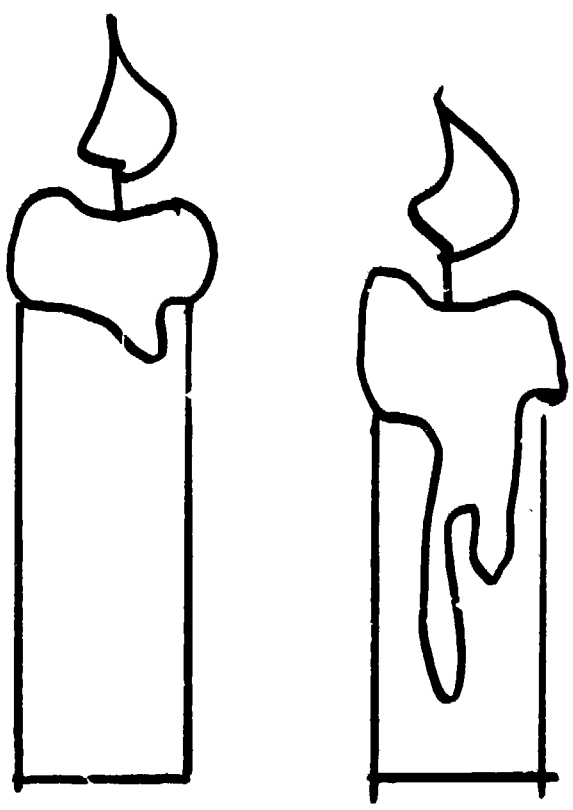
1



2

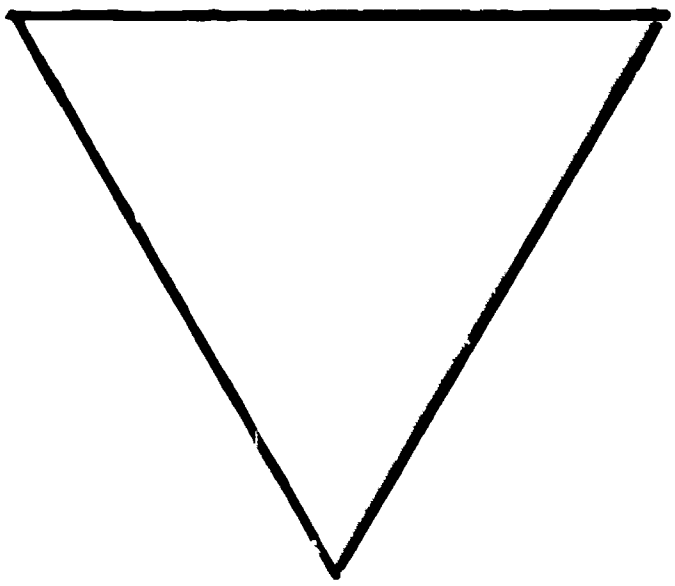


3

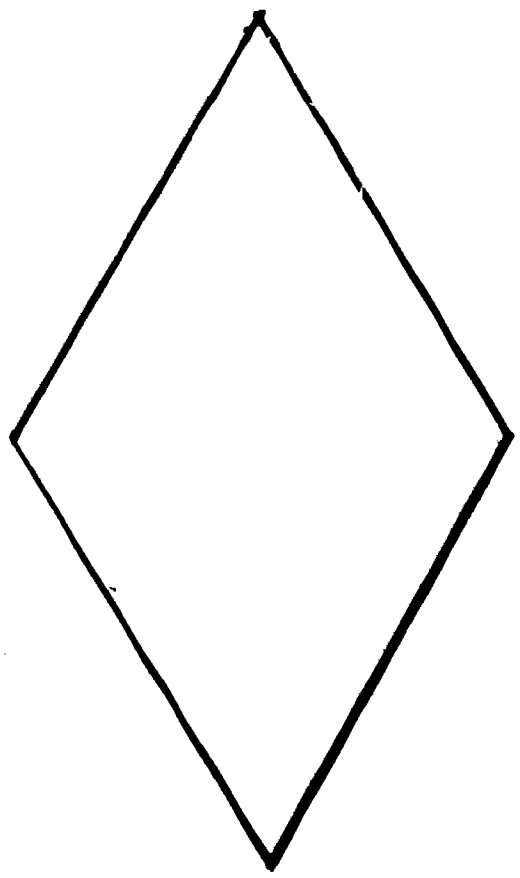


4

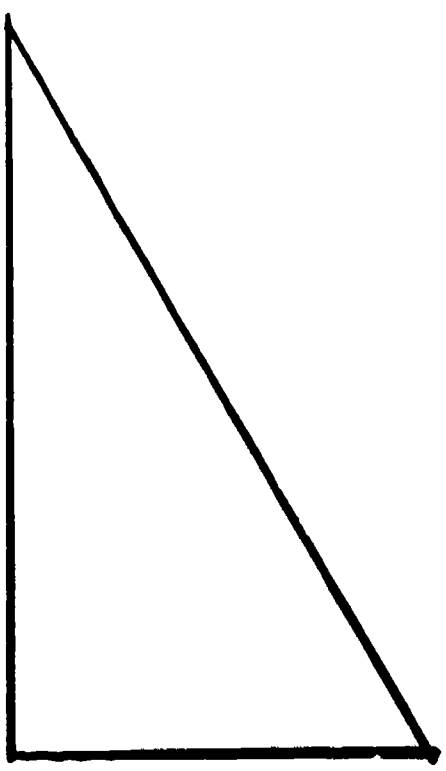
24



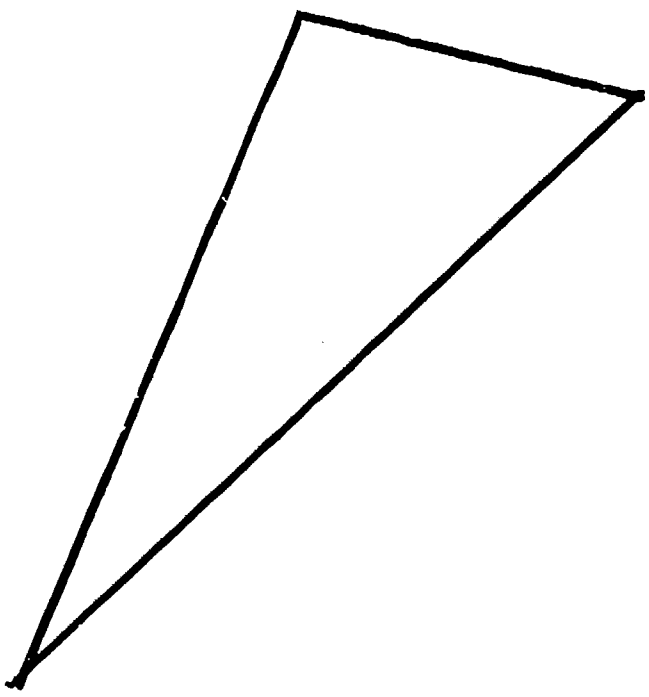
1



2

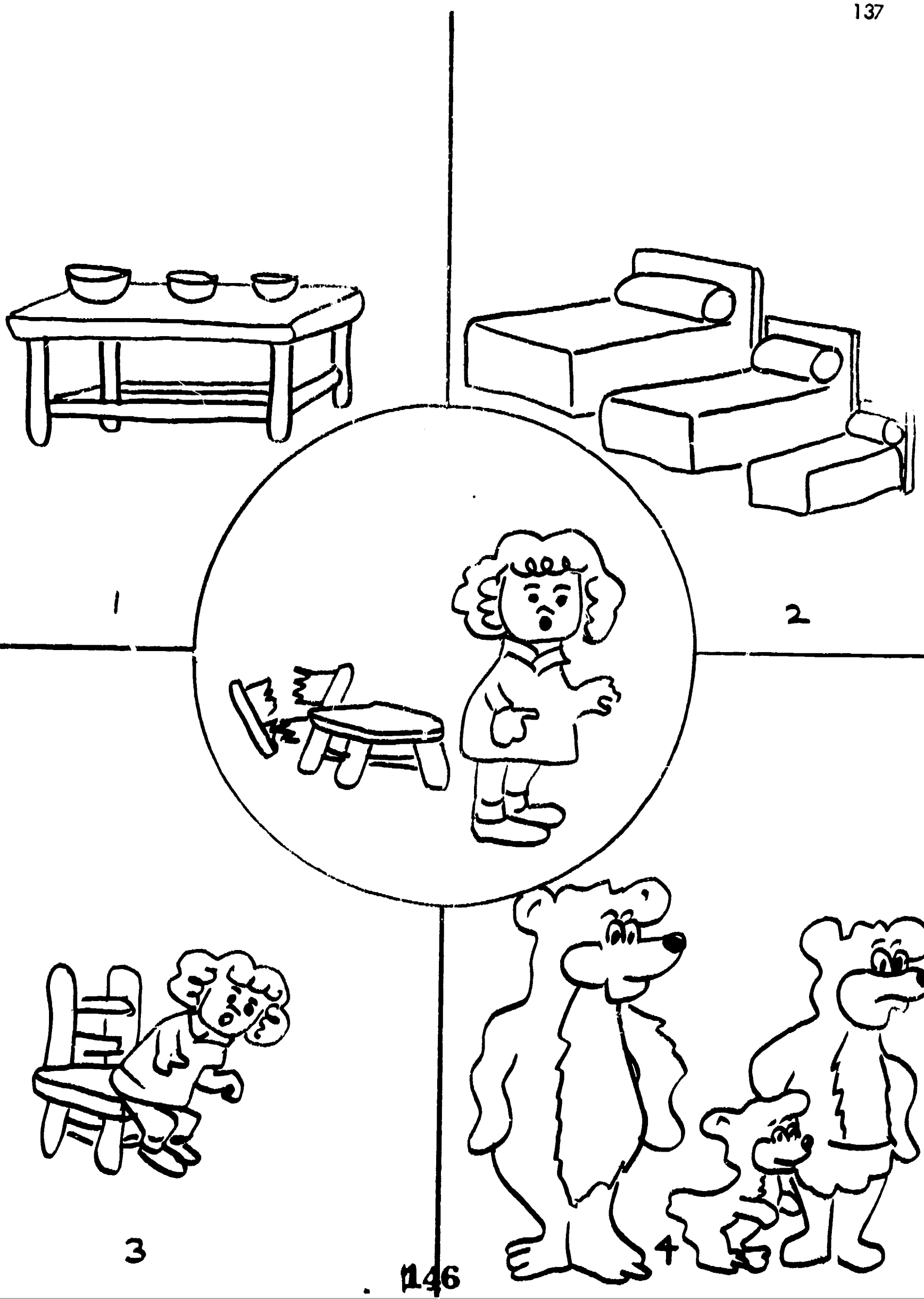


3

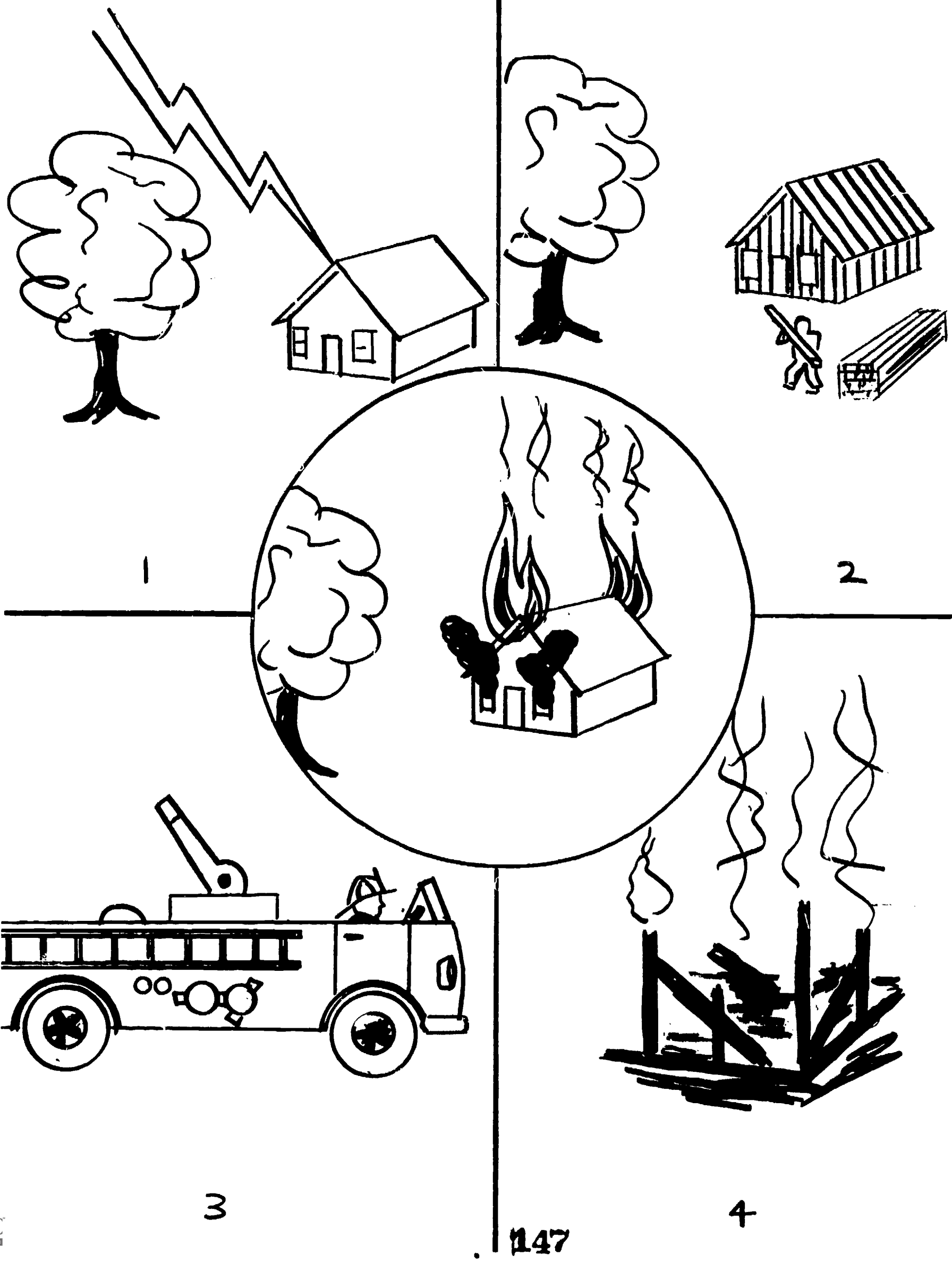


4

EXAMPLE C



25



1

2

3

4

26

JUNE

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

27

20

APPENDIX C

"AROUND THE BEND" BROADCASTS WITH MATHEMATICAL CONTENT

"Around the Bend" was the television element of the Appalachia Preschool Education Program. There were 169 broadcasts between September 30, 1968, and May 23, 1969. Of the 169, there were eighty-four with mathematical content.

Using a four-category classification based on time allocation, broadcasts were: I. primarily mathematical (fourteen minutes or more); II. strongly mathematical (seven to fourteen minutes); III. somewhat mathematical (four to seven minutes); or IV. not mathematical (less than four minutes). The category of the broadcast is found in column one of the following table.

Each program was assigned a working title by the Curriculum Materials Team. The working title was used for identification only; it was not used during the broadcast. These titles are listed in column two. Some broadcasts were repeats; asterisks indicate a title which was repeated.

Column three gives a brief indication of the objectives related to mathematics for each broadcast. A complete statement of the objectives may be found in Appendix A.

Broadcasts in Category IV (Not mathematical) are not included in this listing.

Category	Working Title	Concise Statement of Mathematical Objectives
II	Moving In	Use numbers; state age; problem solving
II	Pet Shop	Problem solving (selecting-rejecting solutions)
I	Same-Different	Classification
II	Baking	Same-different; sorting; more-less
I	Buttons*	Equal sets; more-less; first; one-to-one correspondence
II	Fall I	Classification (objects)
III	Fall II	Same-different
II	Houses	Logical reasoning; sequence of events
II	Family *	Problem solving (analogies)
II	Water Fun*	Conservation (volume)
II	City Trip*	Terms of size relationships
II	Pairs*	Pairs; number of body parts
II	Halloween II	Geometric shapes; spatial relations
I	What is round?	Circle; select geometric shape from an array
III	Wheels*	Geometric shape and name (circle)
III	Texture	Classification (shape, size)
I	One and Two	Number and numeral (1 and 2); sets; one-to-one correspondence
III	Trains	Straight and curved line segments

Category	Working Title	Concise Statement of Mathematical Objectives
III	Puppets*	Classification (size)
III	Left and Right*	Terms of size relationships
I	Market	One-to-one correspondence; sets; classification
I	Four**	Match numeral and set; read and write 1, 2, 3, and 4
III	Fire Station	Sequence of events
III	"B"*	Count to five
I	Large and small	Large-small; largest-smallest; seriation; same-different
II	Thanksgiving	One-to-one correspondence; count to five; classification
III	Hair	Sequence of events
III	Folk Instruments*	Count to five
I	"3"*	Set of three; numeral three; match numeral and set; count to three
II	Space Special	Spatial relationships and terms; sequence of events
III	Christmas I	One-to-one correspondence; count to eight
III	Christmas II	Seriation
III	Christmas IV	Same size-different size
III	Christmas V	Time related terms

Category	Working Title	Concise Statement of Mathematical Objectives
III	Christmas VI	Time related terms
II	New Years	Time related terms; match numerals and sets
III	Airport	Sequence of events
I	Shapes	Geometric figures--circle, square, triangle
III	Inauguration	Today, yesterday, tomorrow
I	"5"	Read and write 5; review numerals one to four; match numerals and sets
III	Winter	Same-different
III	Restaurant	One-to-one correspondence; spatial terms
III	Musical Instruments III	Classification; same-different
I	Form Recognition I	Plane figures--match, identify, name
II	Magnets	Problem solving; cause and effect
I	"6"	Cardinal number one to six; sets; match numerals with sets; equal, more, less
I	"7"	Cardinal number one to seven; sets; match numerals with sets; equal, more, less
II	Days of the Week	Time related terms: today, yesterday, tomorrow, last week, next week
II	Trip to Linda's	Use a two-dimensional map and three-dimensional model to locate points or paths; near, far, close to, beside; time related terms

Category	Working Title	Concise Statement of Mathematical Objectives
III	Taste and Smell	Test and verify possible solutions; time related terms
I	"8"	Cardinal numbers one to eight; count to eight; name sets with numerals; read numerals one to eight.
II	Clay	Conservation by volume; seriation by weight
III	St. Patrick's Day	Matching forms; seriation; classification
II	Air and Wind	Problem solving (selecting-rejecting solutions)
II	Story Time	Sequence of events
I	"9"	Cardinal numbers one to nine; sets; match numerals with sets; equal, more, less
I	Form Recognition II	Identify basic plane and solid figures
I	Clocks	Time related terms; tell time
I	Zero	Identify (name) sets from empty set to nine: read numerals zero to nine; match sets and numerals
III	Easter	Count objects in a set
II	Patty's Neighborhood	Spatial terms; locate points and paths on a map and a model
I	"10"	Identify (name) sets zero to ten; read numerals zero to ten; match numerals and sets
I	Classification	Classify on one or more dimension and different bases; use expanded polar concepts; same-different

Category	Working Title	Concise Statement of Mathematical Objectives
II	Plants and Seeds	Sequence of events; cause and effect; serial correspondence
II	Rain	Cause and effect; sequence of events; select relevant information
I	Size Relationships	Expanded polar concepts
I	Numeral Review I	Sets; cardinal numbers; match numerals with sets
III	French Creek Game Farm	Size relationships
I	Ordinal Numbers	Use "first" to "fifth" correctly
I	Weighing and Scales	Seriation by weight; balance; heavier, lighter; use examples to solve problems
I	Numeral Review II	Cardinal numbers to ten; read zero to ten

APPENDIX D

FAMILY QUESTIONNAIRE AND SUMMARY OF FINDINGS

( ) Package
( ) TV-Visitor
( ) TV
( ) Control

Interview _____
Date _____

APPALACHIA PRESCHOOL EDUCATION PROGRAM
Family Questionnaire
Form O. C. N.

Child's Name _____ Sex F M Age Group 3 4 5

Parent or Guardian _____

Mailing Address _____ Zip Code _____

1. Marital Status
   ( ) Married
   ( ) Divorced
   ( ) Separated
   ( ) Widowed

2. Residence
   ( ) House (owned)
   ( ) House (rented)
   ( ) Apartment
   ( ) Other _____

3. Size of Community
   ( ) Rural Farm
   ( ) Rural Non-farm

4. Number of times family has moved in the past five years _____

5. Siblings enrolled in preschool program

Name	Sex	Age Group
_____	F M	3 4 5
_____	F M	3 4 5

6. Contact person for home visitor
   ( ) Mother
   ( ) Grandmother
   ( ) Babysitter
   ( ) Other _____

7. Siblings not enrolled in preschool program

Name	Sex	Age
_____		
_____		
_____		

8. List other adults living in the home (specify relationship to child)

Name	Relationship
_____	_____
_____	_____

9.

	Age	Last Grade Completed	Occupation	Employer
Mother	____	_____	_____	_____
Father	____	_____	_____	_____

Summary of Family Questionnaire

	Negro	White	Married	Divorced	Separated	Widowed	Single	house: Own	house: Rent	apt	oth	Community: Rural Farm	Community: Rural Non-farm	Number of Moves: 0	1	2	3	4	5+
T_1	7	99	100	0	1	4	1	78	21	-	7	4	101	42	31	15	12	2	3
T_2	2	103	98	1	3	2	1	77	19	-	9	7	98	51	15	14	8	7	10
T_3	4	98	93	3	1	3	2	63	32	-	7	3	96	40	27	13	10	3	3
T_4		22	17		4		1	14	6		1		18	9	5	1	4	1	

Summary of Family Questionnaire continued

	No. children enrolled	Families Enrolled with Children 1	2	3	No. Families Children/Family 1	2	3	4	5	6	7+	Contact Mother	Grandmother	Babysitter	Other
T_1	130	83	22	1	13	40	20	19	9	0	5	95	1	6	3
T_2	124	87	17	1	12	41	27	14	4	4	3	93	9	2	1
T_3	115	84	18	0	6	27	30	15	11	4	9	Not applicable			
T_4	26	20	1	1	Not Reported							Not applicable			

Summary of Family Questionnaire continued

	No. Homes w/ Other Adults	Mother: Average Age	Mother: Last Grade Completed											Mother: Employed
			6 or under	7	8	9	10	11	12	13	14	15	16	17	
T_1	7	31.0	3	1	9	8	8	9	55	3	4	-	4	1	18
T_2	13	30.3	2	2	9	7	15	6	45	10	2	-	5	1	17
T_3	7	31.4	6	3	6	7	16	13	38	5	1	2	0	1	9
T_4		32.2		1	4	1	1	1	9	0	4	0	1		6

Summary of Family Questionnaire continued

	Father																	
	Average Age	Last Grade Completed													Deceased	Unknown	Employed	Unemployed
		6 or under	7	8	9	10	11	12	13	14	15	16	17	18				
T_1	34.8	2	3	7	9	7	4	50	5	8	1	3	-	1	2	4	95	6
T_2	33.9	4	3	11	8	8	5	40	5	5	3	4	1	1	2	5	93	6
T_3	36.0	9	2	14	5	14	7	32	3	3	1	1	1	-	1	9	88	6
T_4	35.9	-	-	1	1	1	2	12	-	-	-	1	-	-	-	4	18	-

APPENDIX E

ANALYSIS OF VARIANCE SUMMARY TABLES

TABLE XX

PEABODY PICTURE VOCABULARY TEST
PRETEST SCORES

Category	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio	Probability Less than .05
T*	3	877.14	292.38	2.32	
A*	2	6041.54	3020.77	24.00	p<.001
S*	1	96.40	96.40	0.77	
TxA*	6	1188.84	198.14	1.57	
TxS*	3	327.24	109.08	0.87	
AxS*	2	359.38	179.69	1.43	
TxAxS*	6	1844.28	307.38	2.44	p<.03
Error	97	12207.45	125.85		
Total	120	22942.27			

*T = Treatment
A = Age
S = Sex

TABLE XXI

PEABODY PICTURE VOCABULARY TEST
POST-TEST SCORES

Category	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio	Probability Less than .05
T*	3	923.28	307.76	2.95	p<.036
A*	2	4978.02	2489.01	23.88	p<.001
S*	1	23.80	23.80	0.23	
TxA*	6	272.16	45.36	0.43	
TxS*	3	1126.32	375.44	3.60	p<.016
AxS*	2	79.84	39.92	0.38	
TxAxS*	6	2258.64	376.44	3.61	p<.003
Error	97	10111.28	104.24		
Total	120	19773.34			

*T = Treatment
A = Age
S = Sex

TABLE XXII

PEABODY PICTURE VOCABULARY TEST
GAIN SCORES

Category	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio	Probability Less than .05
T*	3	363.45	121.15	1.30	
A*	2	191.50	95.75	1.03	
S*	1	24.40	24.40	0.26	
TxA*	6	464.64	77.44	0.83	
TxS*	3	848.13	282.71	3.03	$p < .033$
AxS*	2	269.34	134.67	1.44	
TxAxS*	6	829.46	139.91	1.50	
Error	97	9044.28	93.24		
Total	120	12045.20			

* T = Treatment
A = Age
S = Sex

TABLE XXIII

APPALACHIA PRESCHOOL MATHEMATICS TEST
PART I SCORES

Category	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio	Probability Less than .05
T*	3	352.19	117.73	12.56	p<.001
A*	2	300.70	150.35	16.04	p<.001
S*	1	2.42	2.42	0.26	
TxA*	6	83.70	13.95	1.49	
TxS*	3	48.51	16.17	1.72	
AxS*	2	76.04	38.02	4.06	p<.02
TxAxS*	6	75.84	12.64	1.35	
Error	97	908.89	9.37		
Total	120	1848.29			

* T = Treatment
A = Age
S = Sex

TABLE XXIV

APPALACHIA PRESCHOOL MATHEMATICS TEST
PART II SCORES

Category	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio	Probability Less than .05
T*	3	398.85	132.95	9.31	$p<.001$
A*	2	632.54	311.77	21.83	$p<.001$
S*	1	0.25	0.25	0.02	
TxA*	6	79.98	13.33	0.93	
TxS*	3	73.41	24.47	1.71	
AxS*	2	13.44	6.72	0.47	
TxAxS*	6	220.14	36.69	2.57	$p<.024$
Error	97	1385.16	14.28		
Total	120	2794.77			

* T = Treatment
A = Age
S = Sex

TABLE XXV

APPALACHIA PRESCHOOL MATHEMATICS TEST
TOTAL SCORES

Category	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio	Probability Less than .05
T*	3	1432.29	477.43	13.13	p<.001
A*	2	1786.22	893.11	24.57	p<.001
S*	1	4.21	4.21	0.12	
TxA*	6	263.76	43.96	1.21	
TxS*	3	213.93	71.31	1.96	
AxS*	2	152.12	76.06	2.09	
TxAxS*	6	461.76	76.96	2.12	
Error	97	3525.95	36.35		
Total	120	7840.24			

* T = Treatment
A = Age
S = Sex