DOCUMENT RESUME

ED 220 315 SE 039 077

AUTHOR	Bernstein-Sidney, Ethel
TITLE	Play Area Design and Use - USMES Teacher Resource Book. Third Edition. Trial Edition.
INSTITUTION	Education Development Center, Inc., Newton, Mass.; Unified Science and Mathematics for Elementary Schools, Newton, Mass.
SPONS AGENCY	National Science Foundation, Washington, D.C.
REPORT NO	ISBN-0-89292-017-3
PUB DATE	76
GRANT	SED-69-01071
NOTE	228p.; For related documents see SE 039 060-098 and ED 142 362.
AVAILABLE FROM	ERIC Clearinghouse for Science, Mathematics, and Environmental Education, 1200 Chambers Rd., 3rd Floor, Columbus, OH 43212 ($5.00).
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Design Requirements; Educational Facilities Improvement; Elementary Education; *Elementary School Mathematics; *Elementary School Science; Interdisciplinary Approach; Language Arts; Learning Activities; Mathematics Education; *Playground Activities; *Playgrounds; *Problem Solving; Process Education; Resource Materials; School Safety; Science Course Improvement Projects; Science Education; Social Studies; Teaching Guides; Teaching Methods; *Unified Studies Curriculum
IDENTIFIERS	National Science Foundation; *Unified Science Mathematics for Elementary Schools

ABSTRACT

Promoting changes to improve the design or use of a school's play area is the challenge of this Unified Sciences and Mathematics for Elementary Schools (USMES) unit. The challenge is general enough to apply to many problem-solving situations in mathematics, science, social science, and language arts at any elementary school level (grades 1-8). The Teacher Resource Book for the unit is divided into five sections. Section I describes the USMES approach to student-initiated investigations of real problems, including a discussion of the nature of USMES "challenges." Section II provides an overview of possible student activities with comments on prerequisite skills, instructional strategies, suggestions when using the unit with primary grades, a flow chart illustrating how investigations evolve from students' discussions of play area design and use problems, and a hypothetical account of intermediate-level class activities. Section III provides documented events of actual class activities from kindergarten and grades 5 and 4/6. Section IV includes lists of "How To" cards and background papers, bibliography of non-USMES materials, and a glossary. Section V consists of charts identifying skills, concepts, processes, and areas of study learned as students become involved with the activities. (JN)

This material is based upon research supported by the National Science Foundation under Grant No. SED69-01071. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Contributors

USMES Central Staff

Earle Lomon, *Project Director*
Betty M. Beck, *Associate Director for Development*
Quinton E. Baker, *Associate Director for Adminsitration*
L. Ray Brady, Jr., *Editor/Production Manager*
Ethel Bernstein-Sidney, Stella Gubbins,
Anne Fitzpatrick, *Associate Editors*
John W. Saalfield, *Graphic Designer*
Martha Allegro, Lois Finstein, Felicia Weitzel,
Phyllis Gentile, Nancy Weiner, *Administrative Staff*

University Content and Curriculum Specialists

Gorman Gilbert, University of North Carolina, Chapel Hill, NC
Perry Lanier, Michigan State University, East Lansing, MI
Fritjof Christensen, Saint Olaf College, Northfield, MN

Classroom Teachers

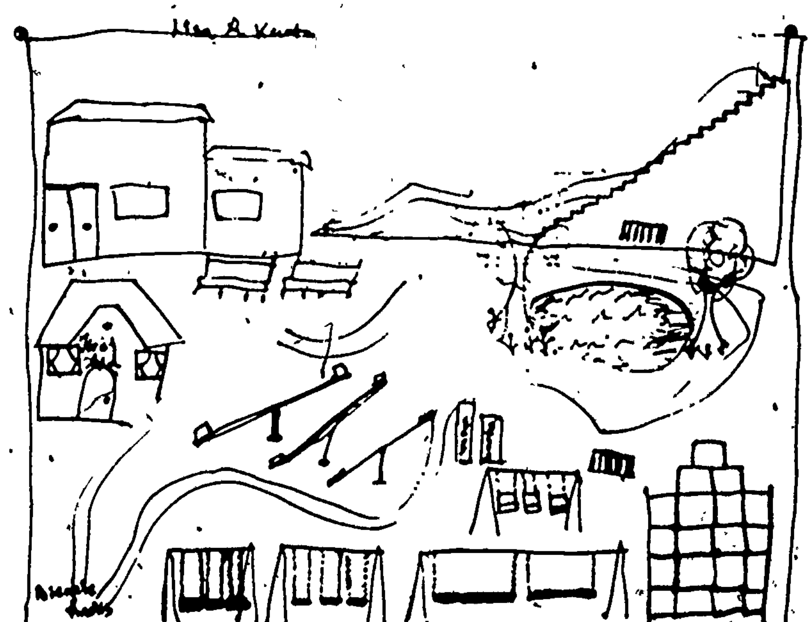
John Arone, Hosmer School, Watertown, MA
Doris Brown, Woodmere School, Portland, OR
James Brown, Shapleigh Memorial School, Shapleigh, ME
Pamela Fazzini, Monte Vista School, Monterey, CA
Robert Grotluschen, Heatherwood School, Boulder, CO
Frances Kassinger, Whitehead Elementary School, Athens, GA
Jeannette Lea, Park View Elementary School, Washington, DC
Eunice Letcher, Nikola Tesla School, Chicago, IL
Michael McCabe, Hardy School, Arlington, MA
Annette B. Schwartz, Cloverdale School, P.S. 213, Bayside, NY
Sheila Sconiers, Ray School, Chicago, IL
Janet Sitter, Allen Street School, Lansing, MI
Mary Szlachetka, Northwestern Elementary School, Eaton Rapids, MI
Josette Wingo, Adams Community School, Washington, DC

This edition of Play Area Design and Use written and edited by Ethel Bernstein-Sidney, supervising editors Betty M. Beck and L. Ray Brady, Jr. Production work performed by Ethel Bernstein-Sidney, L. Ray Brady, Jr. and Martha Allegro. Cover design by John W. Saalfield.

UNIFIED SCIENCES AND MATHEMATICS FOR ELEMENTARY SCHOOLS:
Mathematics and the Natural, Social, and Communications Sciences in Real Problem Solving

Play Area Design and Use

Third Edition



Education Development Center, Inc.
55 Chapel Street
Newton, MA 02160

Trial Edition

Complete USMES Library ISBN: 0-89292-033-5
Play Area Design and Use ISBN: 0-89292-017-3
Education Development Center, Inc., Newton 02160

Printed in the United States of America

CHALLENGE: PROMOTE CHANGES THAT WILL IMPROVE THE DESIGN OR USE OF OUR SCHOOL'S PLAY AREA

Table of Contents

Preface

The USMES Project

Unified Sciences and Mathematics for Elementary Schools: Mathematics and the Natural, Social, and Communications Sciences in Real Problem Solving (USMES) was formed in response to the recommendations of the 1967 Cambridge Conference on the Correlation of Science and Mathematics in the Schools.* Since its inception in 1970, USMES has been funded by the National Science Foundation to develop and carry out field trials of interdisciplinary units centered on long-range investigations of real and practical problems (or "challenges") taken from the local school/community environment. School planners can use these units to design a flexible curriculum for grades one through eight in which real problem solving plays an important role.

Development and field trials were carried out by teachers and students in the classroom with the assistance of university specialists at workshops and at occasional other meetings. The work was coordinated by a staff at the Education Development Center in Newton, Massachusetts. In addition, the staff at EDC coordinated implementation programs involving schools, districts, and colleges that are carrying out local USMES implementation programs for teachers and schools in their area.

Trial editions of the following units are currently available:

- Advertising
- Bicycle Transportation
- Classroom Design
- Classroom Management
- Consumer Research
- Describing People
- Designing for Human Proportions
- #Design Lab Design
- #Eating in School
- Getting There
- Growing Plants
- Manufacturing
- Mass Communications
- Nature Trails
- Orientation
- Pedestrian Crossings
- Play Area Design and Use
- Protecting Property
- #School Rules
- School Supplies
- School Zoo
- Soft Drink Design
- Traffic Flow
- #Using Free Time
- Ways to Learn/Teach
- Weather Predictions

*See *Goals for the Correlation of Elementary Science and Mathematics*, Houghton Mifflin Co., Boston, 1969.

#Available fall 1976.

In responding to a long-range challenge, the students and teachers often have need of a wide range of resources. In fact, all of the people and materials in the school and community are important resources for USMES activities. USMES provides resources in addition to these. One resource for students is the Design Lab or its classroom equivalent: using the tools and supplies available, children can follow through on their ideas by constructing measuring tools, testing apparatus, models, etc. Another resource for students is the *"How To" Cards*. Each set of cards gives information about a specific problem; the students use a set only when they want help on that particular problem.

Several types of resources are available for teachers: the *USMES Guide*, a *Teacher Resource Book* for each challenge, *Background Papers*, a *Design Lab Manual*, and a *Curriculum Correlation Guide*. A complete set of all these written materials comprise what is called the USMES library. This library, which should be available in each school using USMES units, contains the following:

1. *The USMES Guide*

   The USMES Guide is a compilation of materials that may be used for long-range planning of a curriculum that incorporates the USMES program. In addition to basic information about the project, the challenges, and related materials, it contains charts assessing the strengths of the various challenges in terms of their possible subject area content.

2. *Teacher Resource Books* (one for each challenge)

   Each book contains a description of the USMES approach to real problem-solving activities, general information about the particular unit, edited logs of class activities, other written materials relevant to the unit, and charts that indicate the basic skills, processes, and areas of study that may be learned and utilized as students become engaged in certain possible activities.

3. *Design Lab Manual*

   This contains sections on the style of Design Lab activities, safety considerations, and an inventory of tools and supplies. Because many "hands-on" activities may take place in the classroom, the Design Lab Manual should be made available to each USMES teacher.

4. *"How To" Cards*

   These short sets of cards provide information to students about specific problems that may arise during USMES units. Particular computation, graphing, and construction problems are discussed. A complete list of the "How To" Cards can be found in the USMES Guide.

5. *Background Papers*

   These papers are written to provide information for the teachers on technical problems that might arise as students carry on various investigations. A complete list of the Background Papers can be found in the USMES Guide.

6. *Curriculum Correlation Guide*

   This volume is intended to coordinate other curriculum materials with the Teacher Resource Books and to provide the teacher with the means to integrate USMES easily into other school activities and lessons.

The preceding materials are described in brief in the USMES brochure, which can be used by teachers and administrators to disseminate information about the program to the local community. A variety of other dissemination and implementation materials are also available for individuals and groups involved in local implementation programs. They include *Preparing People for USMES: An Implementation Resource Book*, the USMES slide/tape show, the Design Lab slide/tape show, the Design Lab brochure, the USMES newsletter, videotapes of classroom activities, a general report on evaluation results, a map showing the locations of schools conducting local implementation of USMES, a list of experienced USMES teachers and university consultants, and newspaper and magazine articles.

Acknowledgments

Besides the contributors listed at the beginning of the book, we are deeply indebted to the many elementary school children whose investigations of the challenge form the basis for this book. Without their efforts this book would not have been possible. Many thanks to the Planning Committee for their years of service and advice. Many thanks also to other members of the USMES staff for their suggestions and advice and for their help in staffing and organizing the development workshops. Special thanks also go to Christopher Hale for his efforts as Project Manager during the development of this book.

* * *

Because Tri-Wall was the only readily available brand of three-layered cardboard at the time the project began, USMES has used it at workshops and in schools; consequently, references to Tri-Wall can be found throughout the Teacher Resource Books. The addresses of companies that supply three-layered cardboard can be found in the Design Lab Manual.

Introduction

Using the Teacher Resource Book

When teachers try a new curriculum for the first time, they need to understand the philosophy behind the curriculum. The USMES approach to student-initiated investigations of real problems is outlined in section A of this Teacher Resource Book.

Section B starts with a brief overview of possible student activities arising from the challenge; comments on prerequisite skills are included. Following that is a discussion of the classroom strategy for USMES real problem-solving activities, including introduction of the challenge, student activity, resources, and Design Lab use. Subsequent pages include a description of the use of the unit in primary grades, a flow chart and a composite log that indicate the range of possible student work, and a list of questions that the teacher may find useful for focusing the students' activities on the challenge.

Because students initiate all the activities in response to the challenge and because the work of one class may differ from that undertaken by other classes, teachers familiar with USMES need to read only sections A and B before introducing the challenge to students.

Section C of this book is the documentation section. These edited teachers' logs show the variety of ways in which students in different classes have worked at finding a solution to the challenge.

Section D contains a list of the titles of relevant sets of "How To" Cards and brief descriptions of the Background Papers pertaining to the unit. Also included in section D is a glossary of the terms used in the Teacher Resource Book and an annotated bibliography.

Section E contains charts that indicate the comparative strengths of the unit in terms of real problem solving, mathematics, science, social science, and language arts. It also contains a list of explicit examples of real problem solving and other subject area skills, processes, and areas of study learned and utilized in the unit. These charts and lists are based on documentation of activities that have taken place in USMES classes. Knowing ahead of time which basic skills and processes are likely to be utilized, teachers can postpone teaching that part of their regular program until later in the year. At that time students can study them in the usual way if they have not already learned them as part of their USMES activities.

A. Real Problem Solving and USMES

> *If life were of such a constant nature that there were only a few chores to do and they were done over and over in exactly the same way, the case for knowing how to solve problems would not be so compelling. All one would have to do would be to learn how to do the few jobs at the outset. From then on he could rely on memory and habit. Fortunately--or unfortunately depending upon one's point of view--life is not simple and unchanging. Rather it is changing so rapidly that about all we can predict is that things will be different in the future. In such a world the ability to adjust and to solve one's problems is of paramount importance.**

Real Problem Solving

USMES is based on the beliefs that real problem solving is an important skill to be learned and that many math, science, social science, and language arts skills may be learned more quickly and easily within the context of student investigations of real problems. Real problem solving, as exemplified by USMES, implies a style of education which involves students in investigating and solving real problems. It provides the bridge between the abstractions of the school curriculum and the world of the student. Each USMES unit presents a problem in the form of a challenge that is interesting to children because it is both real and practical. The problem is real in several respects: (1) the problem applies to some aspect of student life in the school or community, (2) a solution is needed and not presently known, at least for the particular case in question, (3) the students must consider the entire situation with all the accompanying variables and complexities, and (4) the problem is such that the work done by the students can lead to some improvement in the situation. This expectation of useful accomplishment provides the motivation for children to carry out the comprehensive investigations needed to find some solution to the challenge.

The level at which the children approach the problems, the investigations that they carry out, and the solutions

*Kenneth B. Henderson and Robert E. Pingry, "Problem-Solving in Mathematics," in *The Learning of Mathematics: Its Theory and Practice*, Twenty-first Yearbook of the National Council of Teachers of Mathematics (Washington, D.C.: The Council, 1953), p. 233.

that they devise may vary according to the age and ability of the children. However, real problem solving involves them, at some level, in all aspects of the problem-solving process: definition of the problem; determination of the important factors in the problem; observation; measurement; collection of data; analysis of the data using graphs, charts, statistics, or whatever means the students can find; discussion; formulation and trial of suggested solutions; clarification of values; decision making; and communications of findings to others. In addition, students become more inquisitive, more cooperative in working with others, more critical in their thinking, more self-reliant, and more interested in helping to improve social conditions.

The USMES Approach

To learn the process of real problem solving, the students must encounter, formulate, and find some solution to complete and realistic problems. The students themselves, not the teacher, must analyze the problem, choose the variables that should be investigated, search out the facts, and judge the correctness of their hypotheses and conclusions. In real problem-solving activities, the teacher acts as a coordinator and collaborator, not an authoritative answer-giver.

The problem is first reworded by students in specific terms that apply to their school or community, and the various aspects of the problem are discussed by the class. The students then suggest approaches to the problem and set priorities for the investigations they plan to carry out. A typical USMES class consists of several groups working on different aspects of the problem. As the groups report periodically to the class on their progress, new directions are identified and new task forces are formed as needed. Thus, work on an USMES challenge provides students with a "discovery-learning" or "action-oriented" experience.

Real problem solving does not rely solely on the discovery-learning concept. In the real world people have access to certain facts and techniques when they recognize the need for them. The same should be true in the classroom. When the students find that certain facts and skills are necessary for continuing their investigation, they learn willingly and quickly in a more directed way to acquire these facts and skills. Consequently, the students should have available different resources that they may use as they recognize the need for them, but they should still be left with a wide scope to explore their own ideas and methods.

Certain information on specific skills is provided by the sets of USMES "How To" Cards. The students are referred only to the set for which they have clearly identified a need and only when they are unable to proceed on their own. Each "How To" Cards title clearly indicates the skill involved--"How to Use a Stopwatch," "How to Make a Bar Graph Picture of Your Data," etc. (A complete list of the "How To" Cards can be found in Chapter IX of the USMES Guide.)

Another resource provided by USMES is the Design Lab or its classroom equivalent. The Design Lab provides a central location for tools and materials where devices may be constructed and tested without appreciably disrupting other classroom activities. Ideally, it is a separate room with space for all necessary supplies and equipment and work space for the children. However, it may be as small as a corner of the classroom and may contain only a few tools and supplies. Since the benefits of real problem solving can be obtained by the students only if they have a means to follow up their ideas, the availability of a Design Lab can be a very important asset.

Optimally, the operation of the school's Design Lab should be such as to make it available to the students whenever they need it. It should be as free as possible from set scheduling or programming. The students use the Design Lab to try out their own ideas and/or to design, construct, test, and improve many devices initiated by their responses to the USMES challenges. While this optimum operation of the Design Lab may not always be possible due to various limitations, "hands-on" activities may take place in the classroom even though a Design Lab may not be available. (A detailed discussion of the Design Lab can be found in Chapter VI of the USMES Guide, while a complete list of "How To" Cards covering such Design Lab skills as sawing, gluing, nailing, soldering, is contained in Chapter IX.)

Work on all USMES challenges is not only sufficiently complex to require the collaboration of the whole class but also diverse enough to enable each student to contribute according to his/her interest and ability. However, it should be noted that if fewer than ten to twelve students from the class are carrying out the investigation of a unit challenge, the extent of their discovery and learning can be expected to be less than if more members of the class are involved. While it is possible for a class to work on two related units at the same time, in many classes the students progress better with just one.

The amount of time spent each week working on an USMES challenge is crucial to a successful resolution of the problem. Each challenge is designed so that the various investigations will take from thirty to forty-five hours, depending on the age of the children, before some solution to the problem is found and some action is taken on the results of the investigations. Unless sessions are held at least two or three times a week, it is difficult for the children to maintain their interest and momentum and to become involved intensively with the challenge. The length of each session depends upon the age level of the children and the nature of the challenge. For example, children in the primary grades may proceed better by working on the challenge more frequently for shorter periods of time, perhaps fifteen to twenty minutes, while older children may proceed better by working less frequently for much longer periods of time.

Student interest and the overall accomplishments of the class in finding and implementing solutions to the challenge indicate when the class's general participation in unit activities should end. (Premature discontinuance of work on a specific challenge is often due more to waning interest on the part of the teacher than to that of the students.) However, some students may continue work on a voluntary basis on one problem, while the others begin to identify possible approaches to another USMES challenge.

Importance of the Challenge

Although individual (or group) discovery and student initiation of investigations is the process in USMES units, this does not imply the constant encouragement of random activity. Random activity has an important place in children's learning, and opportunities for it should be made available at various times. During USMES activities, however, it is believed that children learn to solve real problems only when their efforts are focused on finding some solution to the real and practical problem presented in the USMES challenge. It has been found that students are motivated to overcome many difficulties and frustrations in their efforts to achieve the goal of effecting some change or at least of providing some useful information to others. Because the children's commitment to finding a solution to the challenge is one of the keys to successful USMES work, it is extremely important that the challenge be introduced so that it is accepted by the class as an important problem to which they are willing to devote a considerable amount of time.

The challenge not only motivates the children by stating the problem but also provides them with a criterion for judging their results. This criterion--if it works, it's right (or if it helps us find an answer to our problem, it's a good thing to do)--gives the children's ideas and results a meaning within the context of their goal. Many teachers have found this concept to be a valuable strategy that not only allows the teacher to respond positively to all of the children's ideas but also helps the children themselves to judge the value of their efforts.

Role of the Teacher

With all of the above in mind, it can be said that the teacher's responsibility in the USMES strategy for open classroom activities is as follows:

1. Introduce the challenge in a meaningful way that not only allows the children to relate it to their particular situation but also opens up various avenues of approach.

2. Act as a coordinator and collaborator. Assist, not direct, individuals or groups of students as they investigate different aspects of the problem.

3. Hold USMES sessions at least two or three times a week so that the children have a chance to become involved in the challenge and carry out comprehensive investigations.

4. Provide the tools and supplies necessary for initial hands-on work in the classroom or make arrangements for the children to work in the Design Lab.

5. Be patient in letting the children make their own mistakes and find their own way. Offer assistance or point out sources of help for specific information (such as the "How To" Cards) only when the children become frustrated in their approach to the problem. Conduct skill sessions as necessary.

6. Provide frequent opportunities for group reports and student exchanges of ideas in class discussions. In most cases, students will, by their own critical examination of the procedures they have used, improve or set new directions in their investigations.

7. If necessary, ask appropriate questions to stimulate the students' thinking so that they will make more extensive and comprehensive investigations or analyses of their data.

8. Make sure that a sufficient number of students (usually ten to twelve) are working on the challenge so that activities do not become fragmented or stall.

Student success in USMES unit activities is indicated by the progress they make in finding some solution to the challenge, not by following a particular line of investigation nor by obtaining specified results. The teacher's role in the USMES strategy is to provide a classroom atmosphere in which all students can, in their own way, search out some solution to the challenge.

USMES in the Total School Program

Today many leading educators feel that real problem solving (under different names) is an important skill to be learned. In this mode of learning particular emphasis is placed on developing skills to deal with real problems rather than the skills needed to obtain "correct" answers to contrived problems. Because of this and because of the interdisciplinary nature of both the problems and the resultant investigations, USMES is ideal for use as an important part of the elementary school program. Much of the time normally spent in the class on the traditional approaches to math, science, social science, and language arts skills can be safely assigned to USMES activities. In fact, as much as one-fourth to one-third of the total school program might be allotted to work on USMES challenges. Teachers who have worked with USMES for several years have each succeeding year successfully assigned to USMES activities the learning of a greater number of traditional skills. In addition, reports have indicated that students retain for a long time the skills and concepts learned and practiced during USMES activities. Therefore, the time normally spent in reinforcing required skills can be greatly reduced if these skills are learned and practiced in the context of real problem solving.

Because real problem-solving activities cannot possibly cover all the skills and concepts in the major subject areas, other curricula as well as other learning modes (such as "lecture method," "individual study topics," or programmed instruction) need to be used in conjunction with USMES in an optimal education program. However, the other instruction will be enhanced by the skills, motivation, and understanding provided by real problem solving, and, in some cases, work on an USMES challenge provides the context within which the skills and concepts of the major subject areas find application.

In order for real problem solving taught by USMES to have an optimal value in the school program, class time should be apportioned with reason and forethought, and the sequence of challenges investigated by students during their years in elementary school should involve them in a variety of skills and processes. Because all activities are initiated by students in response to the challenge, it is impossible to state unequivocally which activities will take place. However, it is possible to use the documentation of activities that have taken place in USMES trial classes to schedule instruction on the specific skills and processes required by the school system. Teachers can postpone the traditional way of teaching the skills that might come up in work on an USMES challenge until later in the year. At that time students can learn the required skills in the usual way if they have not already learned them during their USMES activities.

These basic skills, processes, and areas of study are listed in charts and lists contained in each Teacher Resource Book. A teacher can use these charts to decide on an overall allocation of class time between USMES and traditional learning in the major subject disciplines. Examples of individual skills and processes are also given so that the teacher can see beforehand which skills a student may encounter during the course of his investigations. These charts and lists may be found in section E.

Ways In Which USMES Differs From Other Curricula

As the foregoing indicates, USMES differs significantly from other curricula. Real problem solving develops the problem-solving ability of students and does it in a way (learning-by-doing) that leads to a full understanding of the process. Because of the following differences, some teacher preparation is necessary. Some teachers may have been introduced by other projects to several of the following new developments in education, but few teachers have integrated all of them into the new style of teaching and learning that real problem solving involves.

1. New Area of Learning--Real problem solving is a new area of learning, not just a new approach or a new content within an already-defined subject area. Although many subject-matter curricula

include something called problem solving, much of this problem solving involves contrived problems or fragments of a whole situation and does not require the cognitive skills needed for the investigation of real and practical problems. Learning the cognitive strategy required for real problem solving is different from other kinds of learning.

3. Interdisciplinary Education--Real problem solving integrates the disciplines in a natural way; there is no need to impose a multi-disciplinary structure. Solving real and practical problems requires the application of skills, concepts, and processes from many disciplines. The number and range of disciplines are unrestricted and the importance of each is demonstrated in working toward the solution of practical problems.

3. Student Planning--To learn the process of problem solving, the students themselves, not the teacher, must analyze the problem, choose the variables that should be investigated, search out the facts, and judge the correctness of the hypotheses and conclusions. In real problem-solving activities the teacher acts as a coordinator and collaborator, not as an authoritative source of answers.

4. Learning-by-Doing--Learning-by-doing, or discovery learning as it is sometimes called, comes about naturally in real problem solving since the problems tackled by each class have unique aspects; for example, different lunchrooms or pedestrian crossings have different problems associated with them and, consequently, unique solutions. The challenge, as defined in each situation, provides the focus for the children's hands-on learning experiences, such as collecting real data; constructing measuring instruments, scale models, test equipment, etc.; trying their suggested improvements; and (in some units) preparing reports and presentations of their findings for the proper authorities.

5. Learning Skills and Concepts as Needed--Skills and concepts are learned in real problem solving

as the need for them arises in the context of the work being done, rather than having a situation imposed by the teacher or the textbook being used. Teachers may direct this learning when the need for it arises, or students may search out information themselves from resources provided.

6. Group Work--Progress toward a solution to a real problem usually requires the efforts of groups of students, not just individual students working alone. Although some work may be done individually, the total group effort provides good opportunities for division of labor and exchange of ideas among the groups and individuals. The grouping is flexible and changes in order to meet the needs of the different stages of investigation.

7. Student Choice--Real problem solving offers classes the opportunity to work on problems that are real to them, not just to the adults who prepare the curriculum. In addition, students may choose to investigate particular aspects of the problem according to their interest. The variety of activities ensuing from the challenge allows each student to make some contribution towards the solution of the problem according to his or her ability and to learn specific skills at a time when he or she is ready for that particular intellectual structure.

B. General Papers on Play Area Design and Use

1. OVERVIEW OF ACTIVITIES

Challenge:

Promote changes that will improve the design or use of our school's play area.

Possible Class Challenges:

Find ways to make our play area less crowded and safer.

Make changes in equipment and game areas to make the play area better for the whole school.

An accident on a piece of equipment that is being incorrectly used, overcrowdedness, or boredom on the part of children whose age group was not thought of when the area was designed may lead naturally to the introduction of the Play Area Design and Use challenge. An investigation of any one of several USMES units including Eating in School, Classroom Design, and Using Free Time may also lead naturally to the investigation of this challenge. During the initial class discussion other play area problems might surface, and the children may decide to survey the rest of the student body before assigning priorities to the various issues raised by classmates. (Observation of the play area during recess and after lunch as well as interviews with teachers who have served as play area monitors may also give them a better perspective of play area problems.)

A group investigating the overcrowdedness of the play area might tally the total number of children who use the area at different times during the day, and the number using each piece of equipment. Another group might measure the physical dimensions of the present play area and space required for each piece of equipment to determine what space is available. Still another group might conduct surveys of schoolmates to determine the preferences for different types of equipment according to the ages of different users of the play area. Data might also be collected on user heights, weights and ages and on dimensions of the equipment such as the distance between rungs of a ladder or height of swings in an attempt to assess whether or not the equipment size is appropriate.

Often students may visit other play areas to investigate alternative designs, facilities or other possible uses of space. If expenditures are necessary, data might be collected on equipment and material costs, and on availability of funding. Fire and safety regulations concerning the materials used might be examined and taken into consideration if any changes are made.

Before implementing any final solutions, the groups can present their proposals to each other and synthesize all their suggested actions into a cohesive program. The children may first have to obtain approval from the principal, school board or PTA before proceeding, thus affording them the opportunity to prepare a unified presentation of their findings and recommendations. They may want to make large and visually effective charts and graphs to communicate certain points; they may write and practice speeches to ensure a clear and complete presentation. Once they have received approval and have taken care of logistics and other details, the children can implement their program for improving the play area which might include rescheduling the use of the play area, relocating the equipment, selecting new equipment or improving existing equipment, and designing new games.

To measure their success, the children might collect data on play area use to see whether safety has been improved or whether overcrowding has diminished. They might conduct attitude surveys to find out how students and teachers feel about the changes.

Some aspects of the students' program may require continued effort. Children may act as monitors to see that litter is disposed of properly and rules followed. A standing committee may be formed to insure that equipment is maintained and used safely. They may periodically devote time to assisting younger children and organize as well as teach new games. When work on the Play Area Design and Use challenge is complete, students might decide to investigate other spatial and scheduling problems in the school as well as the USMES unit on school rules.

Although many of these activities may require skills and concepts new to the children, there is no need for preliminary work on these skills and concepts because the children can learn them when the need arises. In fact, children learn more quickly and easily when they have a need to learn. Consider counting: whereas children usually learn to count by rote, they can, through USMES gain a better understanding of counting by learning or practicing it within real contexts. In working on Play Area Design and Use children also learn and practice graphing, measuring, working with decimals and dividing. Although dividing seems necessary to compare fractions or ratios, primary children can make comparisons graphically; sets of data can also be compared graphically or by subtracting medians (half-way values). Furthermore instead of using division to make scale drawings, younger children can convert their measurements to spaces on graph paper. Division may be introduced at the proper grade level during calculation of percentages, averages, or unit cost of some item.

2. CLASSROOM STRATEGY FOR PLAY AREA DESIGN AND USE

Each USMES unit revolves around a challenge--a statement that says, "Solve this problem." The success or failure of the unit depends largely on (1) the relevance of the problem for the students and (2) the process by which they define and accept the challenge. If the children see the problem as a real one, they will be committed to finding a solution; they will have a focus and purpose for their activities. If the students do not think the problem affects them, their attempts at finding solutions will likely be disjointed and cursory.

The challenge as stated in the Play Area Design and Use Resource Book is general enough to apply to many situations. Students in different classes define and reword the challenge to fit their particular situation and thus arrive at a specific class challenge. For example, the challenge, "Promote changes that will improve the design or use of your school's play area," has been restated by some classes in terms of making changes in areas used by different grades to make the play area better for the whole school.

The Process of Introducing the Challenge

Given that a problem exists, how can a teacher, without being directive, help the students identify the challenge that they will work on as a group? There is no set method because of variations among teachers, classes, and schools and among the USMES units themselves. However, USMES teachers have found that certain general techniques in introducing the challenge are helpful.

One such technique is to turn a discussion of some recent event toward the challenge. For example, a class discussion about the children's play activities during recess may lead to a Play Area Design and Use challenge.

One class of fifth-grade students was asked how they felt about their play area--whether it was adequate or in need of improvement. At the time, separate play areas were provided for children in the primary and intermediate grades. The children discussed both areas and decided that the play area for younger children lacked equipment. They agreed to focus their attention on improving the facility.

Often work on one challenge leads to another. For example, children investigating overcrowding in the lunchroom might discover that schoolmates do not want to go outside after lunch because of the poor condition of the play area.

A group of students might then decide to work on the Play Area Design and Use challenge. When children encounter a problem that leads to a related USMES challenge, one group of children may begin work on the second challenge while the rest of the class continues with the first challenge. However, there should be at least ten to twelve students working on any one challenge; otherwise, the children's work may be fragmented or superficial or may break down completely.

Sometimes the discussion of a broad problem may encompass the challenges of several related units. For example, a discussion of problem areas in the school can lead the students to the challenges for Eating in School, Classroom Design, Design Lab Design, School Rules, Classroom Management, or Play Area Design and Use as the children identify specific problems.

An experienced USMES teacher is usually willing to have the children work on any one of the several challenges that may arise during the discussion of a broad problem. While this approach gives the children the opportunity to select the challenge they are most interested in investigating, it does place on the teacher the additional responsibility of being prepared to act as a resource person for whichever challenge is chosen.

Classroom experience has shown that children's progress on an USMES challenge may be poor if the teacher and students do not reach a common understanding of what the challenge is before beginning work on it. Having no shared focus for their work, the children will lack the motivation inherent in working together to solve a real problem. As a result, they may quickly lose interest.

Interest may also wane if the children's energy is focused on ideas that are unfeasible because of excessive monetary expense. The initial discussion in such an instance might severely dampen the students' enthusiasm. One way to deal with this solution would be for students to establish criteria for evaluating suggested ideas.

Children in a combination third/fourth-grade class were challenged to change their play area in any way they wished. Two groups were formed: one to work on several pieces of equipment for use by younger children, such as a merry-go-round and a sandbox, and another committed to having a gym or swimming pool built. A great deal of time was spent collecting measurement data and drawing plans. In conver-

sations with the principal the children were never questioned on their plans to finance the gym and pool project and, in turn, never questioned the principal. They were encouraged to work on a project that in the end proved too expensive.

Initial Work on the Challenge

Once a class has decided to work on a Play Area Design and Use challenge, USMES sessions should be held several times a week, but they need not be rigidly scheduled. When sessions are held after long intervals, students often have difficulty remembering exactly where they were in their investigations and their momentum diminishes.

After initial discussions of the problem, the children formulate a class challenge, such as, "Find ways to make our play area less crowded and safer." They then list various aspects of the problem and possible approaches to solving it. This procedure is often combined with or followed by preliminary observations and/or opinion surveys.

A multiaged class of fourth, fifth, and sixth graders working on the Play Area Design and Use challenge focused their attention on the blacktop area of the playground and ways to improve it. During the second USMES session, four students observed the area and prepared lists and drawings of existing games which they presented to their classmates when they returned to the room.

Next, the students usually categorize their suggested approaches, grouping similar ideas together. The children then set priorities for the tasks they consider necessary to help solve the problem. Most of these tasks are carried out by small groups of children. As various groups complete their work, their members join other groups or form new groups to work on additional tasks.

However, if too many groups are formed, work on the challenge can become fragmented. The teacher finds it impossible to be aware of the progress and problems of each group; in addition, the small number of students in each group lessens the chance for varied input and interaction.

Refocusing on the Challenge

As a class works on a challenge, the children's attention should, from time to time, be refocused on that challenge so that they do not lose sight of their overall goal. Refocusing is particularly important with younger children because they have a shorter attention span. Teachers find it helpful to hold periodic class discussions that include group reports. Such sessions help the students review what they have accomplished and what they still need to do in order to find some solutions to the problem. These discussions also provide an opportunity for students to participate both in evaluating their own work and in exchanging ideas with their classmates. (Another consequence of having too many groups is that not every group can be given enough time to report to the class, thereby increasing the possibility that the children's efforts will overlap unnecessarily.)

Resources for Work on the Challenge

When children try to decide on solutions before collecting and analyzing enough data or encounter difficulties during their investigations, an USMES teacher helps out. Instead of giving answers or suggesting specific procedures, the teacher asks open-ended questions that stimulate the students to think more comprehensively and creatively about their work. For example, instead of telling students involved in a Play Area Design and Use investigation that their ideas for improvements were unusable because of their cost, the teacher might ask "Who will pay for the materials you need?" or "How much will your improvements cost?" Examples of other non-directive, thought-provoking questions are given in section B6.

The teacher may also refer students to the "How To" Cards, which provide information about specific skills, such as using a trundle wheel to measure large distances or making graphs. If many students, or even the entire class, need help in particular areas, such as using fractions, the teacher should conduct skill sessions as the needs arise. (Background Papers provide teachers with additional information on specific problems associated with the Play Area Design and Use challenge.)

USMES teachers can also assist students by making it possible for them to carry out tasks involving hands-on activities. When children need to collect data on their playground or at other playgrounds, the teacher can help with scheduling and supervision. If the children's tasks require them to design and construct items, the teacher should make sure that they have access to a Design Lab. Any collection of tools and materials kept in a central location (in part

45

of the classroom, on a portable cart, or in a separate room) can be called a Design Lab.

Valuable as it is, a Design Lab is not necessary to begin work on the Play Area Design and Use challenge. The Design Lab is used only when needed, and this need may not arise during early work on the challenge. To carry out construction activities in schools without Design Labs, students may scrounge or borrow tools and supplies from parents, local businesses, or other members of the community.

One class of fifth-grade students worked on the Play Area Design and Use challenge without access to a Design Lab. In the course of their investigations they prepared scale drawings of the play area, tallied the number of children using each piece of equipment, interviewed schoolmates and graphed their data. Without ever using a Design Lab they selected and ordered equipment whose cost was within the amount budgeted.

The extent to which any Design Lab is used varies with different classes because the children themselves determine the direction of the investigations and because construction activities are more likely to occur in some class challenges than in others.

Culminating Activities

Student investigations generally continue until the children have agreed upon and implemented some solution to the problem. They may write letters to officials, make presentations of their recommendations, and, once approval is obtained, implement their program, which might include rescheduling the use of the play area, relocating equipment, selecting new equipment or improving existing equipment, and designing new games.

One class of kindergarten children working on the Play Area Design and Use challenge explored different ways to use tires for play; they decided to use a truck tire as a sandbox on the play court. During the course of the year they visited other play areas, made pictures of the play court, and offered recommendations to officials. Their recommendations were incorporated into plans to redesign the children's play court.

Children in one fifth-grade class whose class challenge was to redesign the play area for younger children were asked to assume responsibility for the expenditure of $2,000 on play area equipment. After much tallying, measuring, surveying, and consulting of catalogs, the children recommended the purchase of several pieces of equipment which were ordered, received, and eventually installed.

After the students have implemented their solution, they evaluate the effects of their changes by observing, by measuring, or by conducting attitude surveys. For example, children might collect data on waiting times for each piece of equipment or area after their improvements have been made and compare this information with data collected earlier.

3. USE OF PLAY AREA DESIGN AND USE IN THE PRIMARY GRADES

Children in the primary grades may become very involved in the Play Area Design and Use unit while working on a class challenge of finding ways to make the play area less crowded and safer, to obtain equipment that is more appropriate for their size, or to change areas used for certain games so that they can make better use of the play area. Although their entry level to the challenge and their sophistication with the investigation will certainly be different from that of intermediate-grade children, they will be able to propose possible solutions, collect and interpret data, and take effective action to meet their challenge. Long waiting periods to use equipment, accidents, or lack of equipment appropriate for primary grades may be the basis for a lively discussion in response to the teacher's questions, "What do you like to do on the play area?" "What are some of the things that you do not like about the play area?" "How could you change it?"

Students in classes from kindergarten through the third grade may react enthusiastically to discussions of their own experiences on the play area--no space to run, swings that are too far from the ground, long lines in which to wait for the slide. In order to maintain the interest and motivation of young children, one must acknowledge the egocentrism inherent in their stage of development and focus investigations around these experiences. Past work has shown that

this is essential to the success of the unit in primary grades.

Class discussions of what the children do on the playground as well as what they would like to do but cannot because of overcrowding or lack of equipment provide a forum for the children to voice their concern and anxieties about the problems they face. A positive response from students to a question about whether they would like to investigate the problem leads naturally to the class challenge, "Make changes in equipment and game areas to make the play area better for our class and other primary classes."

In order to get a complete list of the concerns of their peers, some classes decide to develop and administer an opinion survey to other classes before deciding what to do. Other classes may decide to confine the survey to their own class. A trial within the classroom will quickly show that survey questions should be clear and concise in order to obtain the desired information. The trial will also show that the number of questions should be kept to a minimum because of the time consumed in tallying the results. The children might also decide to survey a sample of students rather than the whole student body.

Once the survey data has been collected, the children will have to put it in a form that can be interpreted; data representation can take the form of simple graphs or charts, the preparation of which is an effective mathematics experience.

In addition to an opinion survey, some classes might decide to make general observations of the present play area to assess the availability of equipment and tally both the numbers of primary students using each piece of equipment and the times when area use is high and low. Children might correlate this information with the survey results to obtain an accurate assessment of the situation on the play area.

Class discussions are held during which time priorities are set. Teachers in some primary classes work with the whole class on one aspect of the problem at a time while others encourage the children to work on different aspects of the problem simultaneously.

Some children who are concerned that the height from the ground to the board swings is too high for primary children may decide, after group discussions, to measure the distance from the sole of the foot to the knee of a sampling of primary children. Once the data is compiled, they might plot the data to see the distribution of measurements and compare the children's measurements with the measured distance from the board swing to the ground. The children will then find the height that is comfortable for most of the children. They may also consider having the swings at more than one height.

The students might also decide to observe other play areas to investigate alternative designs or uses of space. The students might discover that an inexpensive way to provide play area activities would be the design and preparation of a game area. The children would have to determine the size of the area and of the designs as well as locate the necessary equipment and materials, e.g., balls, ropes, and paint and brushes.

To determine the size of the area to be developed, they will need to know the amount of available space and may decide to prepare a rough map of the playground. If a more accurate map is needed, the students might take some measurements by pacing or by using measuring instruments such as trundle wheels, folding rulers, or tape measures. They might then use graph paper to convert their measurements to "blocks" using a scale. If the children do not know how to divide, the sizes of several fractions can be compared by making slope diagrams.* This process would offer the chance for the acquisition of new skills or the practice of old ones.

Students concerned with reducing the number of accidents on the play area may find that much of the problem is due to overcrowding and nonobservance of safety rules. They might calculate the number of classes that use the area for different periods of time during the day and try to rearrange the schedule to insure a more even use. Children might research the existing playground rules and propose new ones based on accident data and their observations. They might suggest that these be posted in every classroom, discussed with their schoolmates, and posted on the play area itself.

Before implementing any final solutions, the children may have to obtain approval from the principal, school board, or PTA. The groups can present their proposals to one another and formulate a cohesive program. This program will then be presented to the appropriate authority.

As these activities continue, frequent class discussions are held in which groups report to the class, decisions are made, and students help each other with problems that develop. Questions (as needed) from the teacher serve as a

*F...merly called triangle diagrams.

continuing focus on the problem and a way of judging which, if any, new skills are needed. The children might decide to evaluate the effectiveness of their efforts after their changes have been implemented. This may be accomplished through observations, attitude surveys, or measurements.

The USMES goal of imparting to children the power of using concrete investigations as the basis for decision making can be realized in the primary grades. The development of interpersonal relations in USMES activities is especially helpful in the development of the "whole" child. In addition, the interdisciplinary nature of the work helps the children see the interrelationship among language arts, mathematics, science, and social science. After working on this specific unit, the children may face other problems with an increased ability to deal with them successfully.

4. FLOW CHART

The following flow chart presents some of the student activities--discussions, observations, calculations, constructions--that may occur during work on the Play Area Design and Use challenge. Because each class will choose its own approach to the challenge, sequences of events given here represent only a few of the many possible variations. Furthermore, no one class is expected to undertake all the activities listed.

The flow chart is not a lesson plan and should not be used as one. Instead, it illustrates how comprehensive investigations evolve from the students' discussion of a Play Area Design and Use problem.

Challenge: Promote changes that will improve the design or use of our school's play area.

Optional Preliminary Activities:

USMES Units: Eating in School — Classroom Design — Using Free Time

---

Possible Student Activities:

Class Discussion: How do you feel about the play area? Is it safe?...overcrowded? Do you have to wait to use the play equipment? Can you find ways to improve the play area and make it serve the needs of you and your friends?

General observation of present play area: available equipment, numbers of students using each piece of equipment, times when area use is high and low.

Data Collection: Design and distribution of questionnaires to find out schoolmates' feelings about play area and suggestions for change.

Data Representation: Tally data collected from observations and questionnaires. Preparation of charts and bar graphs to represent data.

Class Discussion: Reports on observations and opinion survey results. What additional information do we need to decide on possible improvements?

Data Collection: Observation of other play areas.

Data Collection: Collection of additional data on use and physical characteristics of play area. Measurement of area to determine available space.

Data Collection: Design and distribution of surveys to find out user preferences for equipment.

Data Collection: Collection of data on user heights, weights, ages and equipment dimensions.

Data Representation: Preparation of scale drawings or maps of the play area, equipment, and/or game designs. Construction of slope diagrams* to compare space and use factors. Compilation of master schedule of daily use of play area.

Data Representation: Tally of results of survey.

Data Representation: Preparation of charts, bar graphs, histograms, and scatter graphs.

(Continued on next page)

*Formerly called triangle diagrams.

<u>Class Discussion</u>: Group reports. Interpretation and analysis of data gathered in terms of accuracy and adequacy; assessment of size and make-up of sample surveyed; correlation of use and preference data and of data on physical dimensions of children with physical dimensions of equipment. Discussion of feasibility of various ideas in terms of cost, available funds and space; additional information needed.

<u>Data Collection</u>: Acquisition of data on material, labor, and equipment costs.

<u>Data Collection</u>: Investigation of sources for financial aid.

<u>Data Collection</u>: Determination of fire and safety regulations that apply to materials in question.

<u>Data Representation</u>: Preparation of reports and charts to explain data on costs, funding, and regulations.

<u>Class Discussion</u>: Presentation of group reports. Decision of proposed changes and of how to present suggestions to people in authority.

Presentation of recommendations

Implementation of approved changes: rescheduling use of play area, selection of new equipment, design of new games, establishment of play area rules, monitoring system.

<u>Class Discussion</u>: Have changes made a difference in the play area? What and how much of a difference? How can we find out?

<u>Data Collection</u>: Observations of improved play area.

<u>Data Collection</u>: Collection of data on numbers of students using each piece of equipment, time spent waiting in line.

<u>Data Collection</u>: Preparation of attitudinal surveys.

<u>Data Representation</u>: Tally of results of survey, and data collection. Preparation of charts and bar graphs depicting results.

<u>Class Discussion</u>: Group reports. Are other changes needed?

Optional Follow-up Activities:

Study of other spatial problems in school

Other USMES Units:
- *Consumer Research*
- *Classroom Design*
- *Design Lab Design*
- *Weather Predictions*
- *Using Free Time*
- *School Rules*
- *Eating in School*
- *Designing for Human Proportions*

5. A COMPOSITE LOG*

This hypothetical account of an interemediate-level class describes many of the activities and discussions mentioned in the flow chart. The composite log shows only one of the many progressions of events that might develop as a class investigates the Play Area Design and Use challenge. Documented events from actual classes are italicized and set apart from the text.

Shortly after school begins in the fall the teacher asks the children whether or not they are enjoying the time they spend on the play area. Several students complain that the little "kids" eat lunch first and then "hog" all of the playground equipment. They add that the playground aide will not make the younger students stop using the equipment when the older students come out to use the area. Some students say that they do not want to play on the "kid stuff" anyway. They want a larger area on which to play ball.

Children in a fifth-grade class in Shapleigh, Maine, became disgruntled with their playground activities--the boys enjoyed football, but the girls could find no satisfying focus for their energies. Consequently, when they began to complain their teacher challenged them to do something about it. (See log by James Brown.)

The teacher then asks the students if they would like to work on the problem and perhaps come up with some suggestions that would make the play area better for all the students in the school. When the children agree, the teacher suggests that they start by listing the main features about a good playground. They generally agree that it should be exciting and safe for all ages with enough space so that everyone can do what he or she wants. The teacher then suggests that they think about what they would have to do to prove to the principal that there is a problem and consider the changes that would best meet their specifications for a good playground.

During the next session, the list of features is reviewed, and the children come up with a large variety of things to do. One girl says they should observe the children playing on the playground and count the number of students using each type of equipment. Another student suggests that they also find out how old the children are. Still another idea is to find out what kinds of playground equipment the children like best. The teacher responds to the latter suggestion by asking how they could do this. Two or three children answer: "Ask them." "Take a poll." "Conduct a survey."

*Written by USMES staff

Shortly after beginning their investigation of the Play Area Design and Use challenge, children in a combination fifth/sixth-grade class decided to go outside and take a thorough look at the playground. They began their observation by walking around the grassy area and discussing information they would need and preliminary ideas, for example, knowing the size of the play area would be necessary to determine the layout, as well as a list of objects and smaller areas already on the playground. Observing a woman exercising her two dogs on their play area, they asked her to leave and noted that she did not. Before ending the outside observation, the group examined the blacktop area and decided on a plan of action. (From log by Sheila Sconiers.)

A few students say that they are wasting their time because they will not be able to make any changes anyway. The teacher suggests that the students elect a committee to talk with the principal. One student asks what they should say; another says they should wait until they can prove that most children would like the playground improved. The class then agrees to talk with the principal as soon as they have something definite to say.

One combination fourth/fifth-grade class met with their principal early in the course of their investigations. The boys in the room told the principal that they wanted a football field. The principal raised important questions concerning the number of children who would use the field versus the number who use the playground, the changes that would have to be made to the area to create the playing field, the cost of the changes, who would pay for it, and what approval they would need to do it. In addition, he encouraged them to think of other things to do that would improve the play area for everyone who used it. (From log by Josette Wingo.)

After more discussion, the list of things to do contains the following:

1. Count the children using each piece of equipment--record age of child.

2. Find out what play activities the children like best
3. Visit other playgrounds
4. Look at catalogs for cost of various types of equipment
5. Find out how large a space one needs in order to play ball

The list is grouped into three categories and groups are formed accordingly to investigate each aspect—use, opinion survey, and equipment. Members meet in small groups to decide upon the data they need and the best way to collect it.

> *In a fifth-grade class in Monterey, California, the students were asked if it were fun to play on the playground and if there were anything they would like to change. The main problems discussed were lack of equipment, improper use of equipment, and a need for a quiet place. In grouping the playground problems into areas of mutual concern, the children came up with the following areas: equipment, money, and play area procedures. (From log by Pamela Fazzini.)*

<u>Use Group</u>

One day the group spends the last half of their lunch period observing the general use of the playground. Back in the classroom after lunch they discuss what they saw, and two common items emerge. All members agree that there was a lot of congestion at the slide and that many people were not doing anything. During the preliminary group discussion the students agree that the data they collect must answer the following questions posed by their classmates:

1. How long do the children have to wait for a turn at each piece of equipment?
2. How many students stand around with nothing to do?
3. How long does each child use the slide?
4. Which equipment is used mainly by primary-age students?...intermediate age students?

Since age is a factor and presently the recesses are scheduled by age and the lunches are mixed, the group plans to collect two sets of data: one during a recess for primary students and the other during a recess for intermediate students.

During a class discussion the group is asked exactly how they are going to collect the data. The group meets to consider the problems involved in each task and decides to (1) count the number of children who use each piece of equipment during the half-hour recess, (2) count the number of students waiting to use the slide every five minutes, (3) count the number of children in a given area of the playground "doing nothing" at five minute intervals, and (4) spot check every fifth child waiting at the slide timing him/her from the time he/she joins the line until he/she is sitting at the top ready to go down. They elicit additional "people power" from their classmates to do the job.

In the fourth-grade class in Washington, D.C., the students tallied--

50 children on slide #1
68 children on slide #2
8 children on the monkey bars

The teacher asked why there were so few children on the monkey bars. The response was that they were too high. The students wondered how many children weren't playing at all on the playground. They checked with the teachers to find out the total number of children in the class as well as the number that went home to eat lunch. When quite a few children were still unaccounted for, the students revealed that some went to the "real" playground--the area designated for children in grades four through six. (See log by Jeanette Lea.)

Opinion Survey Group

The children in this group meet and prepare a draft of a questionnaire that they then try out on their classmates. They find that it takes a long time to tally the results of so many questions. The drafted questionnaire includes several yes/no questions ("Do you get to play on the equipment you like best?" "Do you think you have to wait too long in line?"), a list of playground equipment with blanks next to each item to indicate choices (1-10), and a question asking opinions on possible new equipment.

ACTIVITY OPINION SURVEY

Our class is trying to make the playground better. We would like to know what you like to do on the playground. Please check the four (4) things on the list that you like to do most.

___climb	___play basketball
___slide	___hopscotch
___swing	___play catch
___play baseball	___play dodgeball
___play tetherball	___other:

Figure B5-1

The survey group debates whether or not their questionnaire as written will elicit the information they need. They decide to rewrite it and have it take the form of a preference survey on different types of activities, e.g., playing baseball, climbing, sliding. A copy of their survey can be seen in Figure B5-1.

The next question to be raised by the group is how many classes to survey. After considerable discussion the children decide to poll the two other classes at their own grade level to see how different the results are. They find, based on data from students at their grade level, that there is little difference in the results. Based on this information, the group decides to conduct its opinion survey in one class per grade.

In an effort to be responsive to the needs of the primary students whose playground they were trying to improve, a group of fifth-grade students in Washington, D.C., arranged to interview small groups of children from the three lower grades. Each group was asked for their ideas for new playground equipment. The interviewers kept a record of their suggestions that included swings, merry-go-round, sand box, and bumping cars. These were later listed on ballots for primary students along with equipment suggested by the fifth-grade students. (See log by Jeanette Lea.)

Equipment Group

During the first meeting of the equipment group the children decide to examine equipment catalogs to gather data on various types of equipment and costs. One student suggests that the children also visit other playgrounds both as a group and on their own. After obtaining catalogs the youngsters spend several sessions looking at different types of apparatus and taking notes. They are shocked at the cost of playground equipment and begin to think of things they might construct themselves. In addition to types of equipment and their costs the children speculate on the number of people who could use each piece of equipment and collect data on the space requirements of each. They feel that this information will be important in deciding which equipment to get.

The children visit other play areas close to their homes after school and discuss what they saw with other members

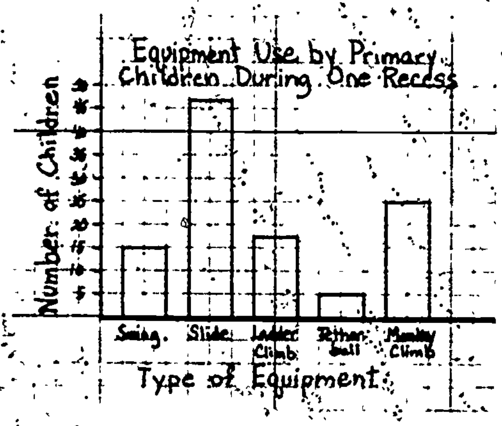


Figure B5-2

of the group. Two parents volunteer to drive the students to a particularly well known play space in the city during school hours. The children return with many ideas and increased enthusiasm.

During the next class discussion scheduled for the groups to share their information with the class, the children in the "use" group begin to relate their findings. They are interrupted by several students who complain that they are having difficulty understanding and remembering the figures. Others agree, and it is established that none of the groups have graphically represented their data. The children decide to adjourn the meeting until each group has organized and graphed their data.

By the end of the week someone from each group reports to the teacher that his/her groupmates are ready for another class discussion. On the following Monday children in the "use" group begin the session. They present their graphs comparing the use of various pieces of equipment during one recess period. (Separate graphs were made for primary recess and intermediate recess.) The data collected during one primary recess is shown below. Figure B5-2 shows the graph that the children have made from this data.

Table of Values

Type of Equipment	No. of Primary Children Using Equipment
Swing	15
Slide	47
Ladder climb	17
Tetherball	5
Monkey climb	25

The group reports that they feel that despite the large number of children who used the slide during the period, there were many others who wanted to but didn't try because of the line of children waiting. To support their statement, the students report that the median number of children waiting for the slide was nine with a median waiting time of three minutes. The group also shows a bar graph that indicates the number of youngsters "doing nothing" in different areas of the playground for one recess. (The sectioning of

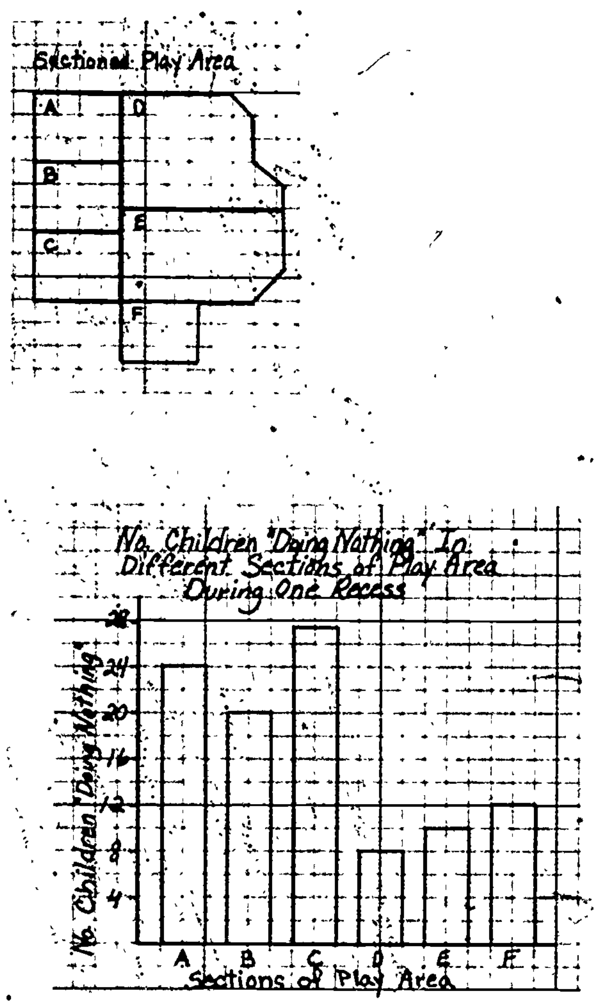


Figure B5-3.

the play area and bar graph are shown in Figure B5-3. The data that they have collected and from which they have worked is shown below.)

Table of Values

Sections of Play Area	No. of Children "Doing Nothing"
A	24
B	20
C	27
D	8
E	10
F	12

The class notes that children "doing nothing" tend to congregate in the open space (sections A, B and C) where there is neither equipment nor organized games. In addition, someone from the opinion survey group states that their data correlates with the findings of the use group in that the most popular activities turned out to be climbing for the intermediate children and sliding for the primary-age students. The attention of the class shifts to the "opinion survey" group, and its members present the bar graph depicting the results of the survey of the primary grades (see Figure B5-4). The data used for this graph is shown below. (A similar graph was made for the intermediate grades.)

Table of Values

Activity	No. of Children
Climbing	35
Sliding	45
Swinging	40
Playing ball	10
Hopscotch	25
Catch	15
Dodgeball	20
Basketball	5
Other	25

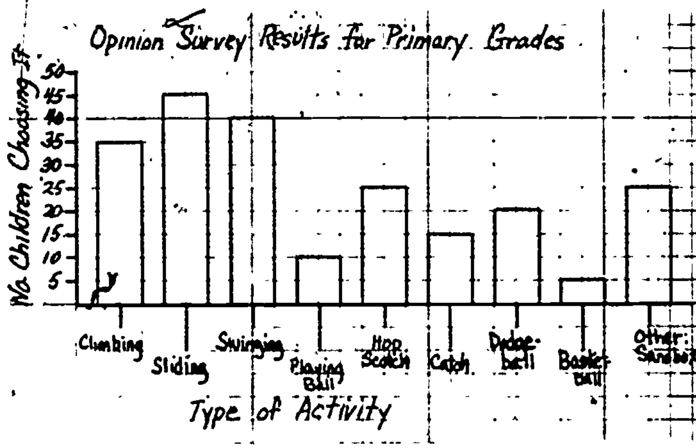


Figure B5-4

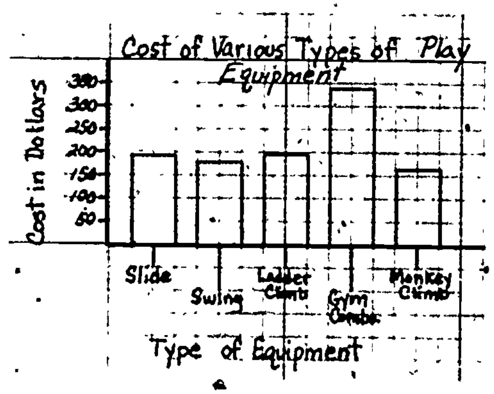


Figure B5-5

Members of the "equipment" group present a report of their visits to other playgrounds and a graph that depicts the catalog price of various pieces of equipment. (See Figure B5-5 for graph. The data table is shown below.)

Table of Values

Type of Equipment	Cost in Dollars
Slide	190
Swing	170
Ladder climb	195
Gym combination	340
Monkey climb	157

The children recommend purchasing or building a combination gym structure, adding that their recommendation is supported by the survey and use data. A classmate remarks that it would be the most expensive item to add to the play area. But another child interjects that children could use it for lots of different activities--climbing, swinging, and sliding--and that it would take up less space and cost less than three separate units.

They all agree that there is a need for more equipment for certain activities but also that there is a need for more information before they can go to the principal.

1. Where would we put the equipment?
2. How big will it be?
3. Where will we get the money to buy it?
4. What can we do until then?

The children decide to regroup to investigate space, scheduling and rules, and equipment.

Space

The youngsters in the "space" group gather the next day for their first meeting. The children decide that their first task should be to prepare a scale drawing of the play area. To its dismay, the measuring group finds that the playground area is irregular with small sections chopped out of some of the boundaries. The problem is resolved by dividing a rough sketch of the area into measurable sections. Using trundle wheels plus some approximation (by comparison) of hard-to-measure sections, they produce a reasonably accurate scale drawing of the space. (See Figure B5-6.)

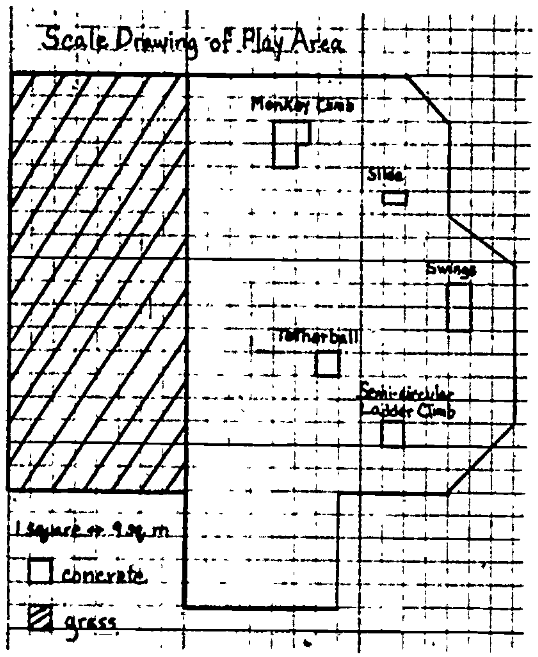


Figure B5-6

After a fourth-grade class in Boulder, Colorado, spent several sessions discussing the problem, one student proposed that they build a model. The teacher asked what they needed to know in order to construct a model. The response was immediate--the size of the area. The results of measuring the area with different instruments were varied. After deciding to use a trundle wheel, the students discussed the problem of dips and bumps in the ground and the fact that one boundary included a curve. The students decided to measure around the curve and ignore the dips and bumps in the ground. Subsequently, a scale model was built on a scale of one inch representing four yards. After discussing the problem of accuracy of the model, the students decided that fractions of inches could be dropped. (From log by Robert Grotluschen.)

One problem facing a fifth-grade class was the size of the play area. The boundaries were unclear and they didn't know how large it was. One girl suggested that the class call the superintendent and ask for a copy of the deed. Two days later a copy of the deed was received; the directions described in the deed and the monuments referred to in it were enough for the children to ascertain the unknown markers. Two boys used the "How To" Cards about measuring large distances and constructed two trundle wheels that the children used to take the measurements. The class then prepared a scale drawing of the area. (See log by James Brown.)

Children in a kindergarten class had to determine the size of a truck tire that would fit in their play court to serve as a sandbox. A parent had offered to locate one for the class when he was told the appropriate size. The children went outside to see where it would go and how big it should be. Once a spot was selected, the children got a jump rope *and measured the play court. They discovered that the play court was five jump rope lengths wide and decided that the sand area should be one jump rope length wide. (See log by Doris Brown.)*

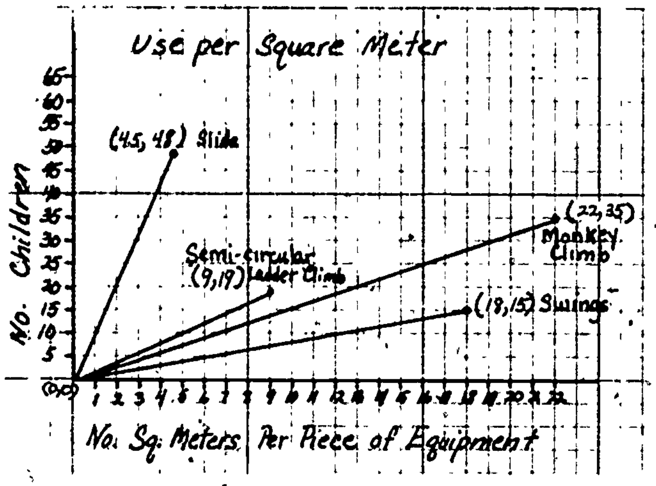


Figure B5-7

When the scale drawing is complete, the group meets to discuss what else they should do. They decide to compare the space needed for different types of equipment with the number of children who can use each one. The children agree that this information will be useful in making final recommendations but are unsure of how to do it. Two students remark that they saw a set of "How To" Cards that might be helpful. They excuse themselves and return several minutes later with the set of "How To" Cards, "How to Make a Slope Diagram."* The rest of the session is spent reading the cards and gathering the necessary data.

During the next session, the children find that the ratios are easily compared by making a slope diagram. (See data table below and slope diagram in Figure B5-7.) Upon examining their diagram, they note that the line with the steepest slope is that representing the slide. They interpret this to mean that the slide offers the most use per square meter, followed by the semi-circular ladder climb unit with the second steepest slope.

Table of Values

Type of Equipment	Child Use in One Recess	Space in Square Meters
Slide	48	4.5
Semi-circular ladder climb	19	9
Monkey climb	35	22
Swings	15	18

Scheduling and Rules Group

This group of children meet to investigate ways to improve the play area until the changes can be made. Their purpose is to reduce accidents and crowding which in turn would lead to better use of the equipment. The students

*Formerly called triangle diagram.

agree that improved scheduling would reduce crowding at certain pieces of equipment and make the play area a better, more enjoyable place.

They discover that as many as four classes use the play space during one recess period. Sometimes all are from the same age grouping--intermediate or primary--while at other times there is a mixture of primary and intermediate grades. Observations made during recess periods show that there is a general "free-for-all" with accidents occuring in the open space when mixed ages of children attempt to use the same area for different purposes. They also observe that when only one age group uses the playground, some pieces of equipment are used very little.

The group checks their observations by comparing the bar graphs that show the use of equipment by primary and intermediate grades. The teacher tells them that it would be easier to make the comparison if they draw a line chart that shows both sets of data. After referring to the set of "How To" Cards on making a line chart, two students make one for the group to examine. (See Table of Values below and line chart in Figure B5-8.) The group decides that it is clear that primary children like slides the best while intermediate children like the monkey climb the best.

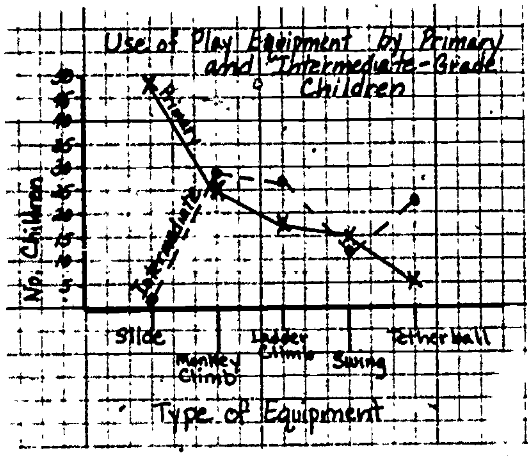


Figure B5-8

Table of Values

Equipment	Use by Primary Children	Use by Intermediate Children
Slide	47	2
Monkey climb	25	29
Ladder climb	17	27
Swing	15	12
Tetherball	5	23

After examining a schedule of recess periods that they obtain from the school secretary, the students propose that recess periods be scheduled for two classes at a time--one primary class and one intermediate class. This, they feel, would reduce crowding at certain pieces of equipment. The youngsters also decide to recommend that the equipment area remain open for use by mixed ages but that the open play space--the area without equipment--be divided into two spaces, one for younger children and one for older children.

In this way children could still mingle across age groupings but have separated play space for their different types of activities.

In addition to making changes in scheduling, the children formulate the rules listed below to govern the use of the play area.

1. The equipment area may be used by children of all ages.
2. Children must use the open play space for their age level.
3. Running games must take place in the open play space, not in the equipment area.
4. No "butting" ahead in line; remember that everyone wants a turn.
5. No pushing.
6. Put trash in the barrels--let's keep our play area clean.

These rules are shown to the principal who asks that they be presented at the next faculty meeting. Two children volunteer to attend the meeting to share information with the teachers about the work they are doing, and to ask for their help in making the project a success.

Shortly after a few pieces of equipment had been erected by fifth graders in Shapleigh, Maine, a parent telephoned to express her concern about the safety of the equipment. I relayed the message to the class, and the students resolved the issue. One boy suggested, and all the other children agreed, that rubber tires be cut and attached to the wooden uprights to cushion any impact that might occur. Each group wrote up rules to govern the use of their apparatus as well as alternative methods of enforcement if the rules were not followed. The children also decided that rather than ask the teachers to supervise activities on their playground equipment, they would assume this responsibility. (See log by James Brown.)

Equipment Group

The children in this group meet to discuss the distance between rungs on the climbing apparatus. During an earlier discussion, the class had recommended acquiring a combination gym structure, and these youngsters want to make sure that it can be used by both primary and intermediate students. After a great deal of discussion the students decide that knowing the knee-to-floor measurement of the user is essential if the rungs are to be an appropriate distance apart. One student observes that measuring each child in the school would produce a large amount of data. Another youngster suggests that they measure six children selected at random from each grade level. The knee-to-floor measurements in centimeters of the thirty-six children in the sample are 24, 25, 26, 28, 29, 30, 49, 50, 51, 53, 46, 45, 44, 43, 40, 41, 35, 37, 34, 32, 33, 29, 25, 28, 34, 41, 32, 45, 43, 51, 34, 29, 29, 43, 45, 49.

Fifth graders divided into groups to measure everybody who might use the play area equipment. They decided that this was necessary data to have in order to determine how big the play apparatus should be. Further discussion helped them select the specific dimensions to measure--height, weight, hip width, length of arms, and length of legs. Each group arranged a time to take the necessary measurements. During a reporting session, the children discovered that the various groups took their measurements differently--some with shoes on, others with shoes off. They established standards to follow to increase their accuracy and took a second set of measurements. (See log by James Brown.)

During the next session the children in the group meet to decide on two distances for the ladder climb rungs. They have a difficult time working with their data. The teacher asks whether they know of some way to organize and represent their data that will help them determine the appropriate rung distances. The group decides to construct a histogram showing the number of children who have each knee-to-floor measurement. (See Table of Values in margin and histogram in Figure B5-9.)

When the histogram is analyzed, they discover that the data clusters into two ranges, and they find that the medians of the two groups are 29 cm and 45 cm. The youngsters see that these two distances between rungs would offer every child in the school an appropriate ladder climb.

Table of Values

Number of Children	Knee-to-Floor Measurements in Centimeters
1	24
2	25
1	26
0	27
2	28
4	29
1	30
0	31
2	32
1	33
3	34
1	35
0	36
1	37
0	38
0	39
1	40
2	41
0	42
3	43
1	44
3	45
1	46
0	47
0	48
2	49
1	50
2	51
0	52
1	53
0	54
0	55

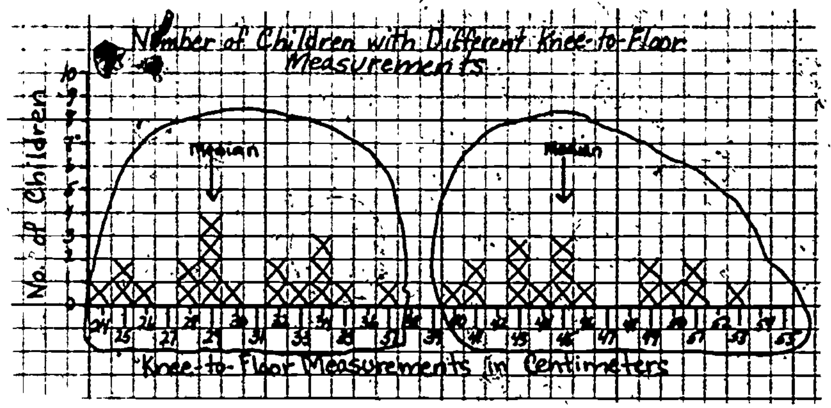


Figure B5-9

After agreeing that they have all the necessary information, the class appoints a committee to see the principal about their recommendations. Students on the committee gather to plan their meeting with the principal scheduled for later in the week. The children agree to trace for her their work on the problem and to present the data they have collected to date as well as their preliminary recommendations for rescheduling and for the acquisition of a combination gym apparatus.

The principal listens attentively to the committee members. She is impressed by the thoroughness of their investigations. She tells them that the PTA has a school improvement fund and that there might be a chance to use some of the money to improve the play area. Before the presentation ends, the principal advises the children to prepare two proposals--one for the PTA requesting funds to buy additional equipment and one for her containing recommendations for rescheduling recess.

The next week the class meets to hear the report on the meeting with the principal. They agree to work together to write the proposal for the PTA based on information they have collected.

After much discussion the class agrees on final recommendations. Using the results of the opinion survey on activ-

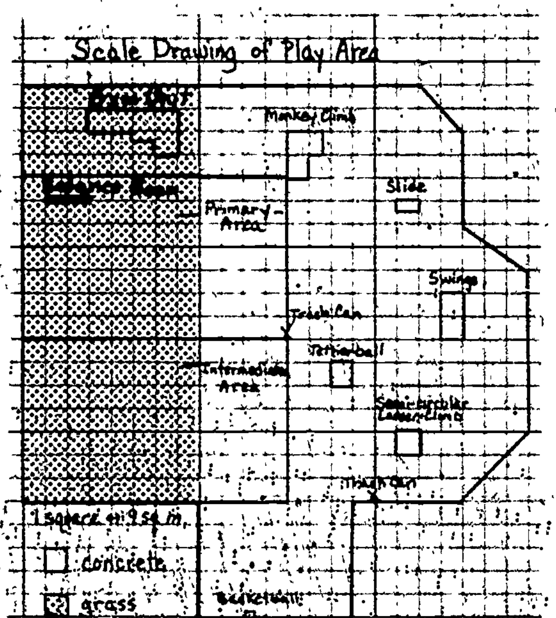


Figure B5-10

ities preferred, the projected and calculated use of the various pieces of equipment, the amount of available space, the investigation to determine the equipment that would provide the most usage for the least amount of space, and site visits to other playgrounds, the children propose that funds be used to purchase a complex unit that would combine climbing, sliding, and perhaps swinging and that would be appropriate for primary as well as intermediate-grade children. They make a point that the climbing part should have two sections, one with rungs 29 cm apart and the other with rungs 45 cm apart. In addition, they propose that any extra money be used to buy jumpropes, kick balls and big, soft rubber balls, a balance beam, basketball hoop, and paint with which to paint court games. The space group determines the location of the new equipment on the scale drawing that will be in the proposal along with other supporting data, including graphs and the opinion survey. (See Figure B5-10.)

The students in Lansing, Michigan, remarked that the lines marking the games painted on the blacktop portion of the playground had faded. Their first project was to design variations of the games and repaint the lines in bright colors. The students worked for several weeks figuring out several different ways to play hopscotch, four-square, dodgeball, circle ball, and basketball on a practice court. They scrounged paint and successfully completed the painting. (See mini-log by Janet Sitter.)

In addition to the more traditional types of equipment such as swings and seesaws, fifth graders in Shapleigh, Maine, designed two interesting additions to their play area. One was an adjustable-height "battle horse" that consisted of a fifty-gallon drum suspended by rope from four wooden posts with additional rope extending from either end of the drum and much hay on the ground directly underneath it. The object of the equipment was for one child to stay on the drum as long as possible while other children pulled on the ropes extending from each end of it. Another interesting design called for construction of an obstacle course consisting of a tire climb, hurdles, a rope swing, and open drums through which to crawl. (See log by James Brown.)

The youngsters in the "scheduling and rules" group write up their recommendations (listed earlier) in proposal form along with the justifications for them and plan to submit the material to the principal. The class spends several sessions preparing their materials. Before the final copy is made, drafts are submitted to the class for approval. When the proposals are given to the president of the PTA and the principal, the children are told that action will be taken within two weeks.

One week later the principal and president of the PTA arrange a meeting with the class. The children are visibly excited as the scheduled time approaches. During the session, the principal tells the children that, based on talks with teachers and an examination of schedules, she has decided to implement their changes on a trial basis for one month effective in two weeks. She asks that the class use the interim to inform other classes of the new plan and rules and to formulate evaluation procedures to be applied during the trial period.

The president of the PTA continues by reporting that favorable action has been taken on the proposal submitted to them. Saying that it was endorsed by the principal and other faculty, the PTA has appointed two members to work with the class in implementing their plan. He gives the "go-ahead" for the purchase of small equipment and suggests that the children investigate the possibility of contracting with a private company to build the gym apparatus rather than purchasing a prefabricated unit. The PTA president suggests that the children compare costs and time involved in both alternatives before making a final decision. He tells the children that the two representatives from the PTA will get in touch with them early the next week. Before leaving, both adults compliment the children on their work.

Students in a combination fourth/fifth-grade class invited the school's Community Relations person to the class to hear plans for their playground project. After the discussion he asked them to write up their requests in proposal form and to submit them to the Adams Community School Board. The children worked on the proposal for several weeks and submitted and received notification of favorable action by the Board. A committee was established to work with the children on their plans to improve the play area. (From log by Josette Wingo.)

Children in a combination fourth/fifth-grade physical education class in Brooklyn, New York, demanded that a second punchball field be made for the exclusive use of the girls. In order to specify the size of the field the students worked in groups to design playing skills tests to determine the area necessary for playing punchball. These tests were revised whenever first trials indicated that changes were necessary. The data were collected by pairs of students who kept records, made graphs, and evaluated their results. Consumer research was done on various types of paint before the children decided which best met their needs. The area was measured and mapped before the final work of setting up the two fields was completed. Many skills were learned and practiced in the course of their investigations, for example, using fractions of seconds when measuring running speed with a stopwatch, measuring distances, and using ratios. (From log by Annette Schwartz.)

After the meeting the children excitedly discuss the results of their work. The "equipment" group is given the responsibility of preparing orders for small equipment that will be discussed with the class and PTA representatives before being placed. A small group of children organize to formulate an evaluation plan for use during the trial period. The rest of the class decides to work on a Mass Communications challenge with the goal of informing the student body of their work on the Play Area Design and Use challenge and publicizing the impending changes.

6. QUESTIONS TO STIMULATE FURTHER INVESTIGATION AND ANALYSIS

- What do you like to do on playgrounds?
- What are some of the things that you or other children don't like about playgrounds?
- Where do you like to play inside the school? Outside the school? What do you do there?
- How do you feel about the play area? Is it safe? Do you have to wait to use the play equipment?

- Who uses the area besides us? What do they think? How could we find out?

- Is there equipment for younger children as well as for older children? How many children use each piece of equipment?

- How could you make your play area better?

- What kinds of changes would you like to make? How could you make the play area less crowded? What new equipment would you like to have? What is it like?

- What would you need to build your apparatus? Where can you get those things? Who would pay for it? How big should your apparatus be? How strong?

- How easy would it be for someone to hurt themselves on your play area equipment? Can you do something to reduce the number of accidents?

- How do you know whether your equipment will fit in that area? Where should each piece of equipment go on the area?

- Is there anyone who might be interested in your plans? Do you need someone's approval? How can you clearly show someone else what your plans are?

- What kind of measurements do you need to make?

- What might you use to take the measurements? Is one tool better than another? How do you know?

- How accurate do you think your measurements should be? Is it important to know this? How can you check them?

- How often should the equipment/games be changed?

- What data would you need to collect?

- How would you organize yourselves to collect the data you need?

- What is a good way to make a picture of your data?

- What does your data tell you?
- What recommendations could you make based on your data?
- How could your recommendations be tried out?
- How could you find out whether your improvements have made a difference?

C. Documentation

1. LOG ON PLAY AREA DESIGN AND USE

by Doris Brown*
Woodmere School, Kindergarten
Portland, Oregon
(September 1974-June 1975)

ABSTRACT

This kindergarten class was very excited by the Play Area Design and Use challenge because their playcourt was completely bare with no equipment at all. They spent about an hour to and hour and a half on the unit each week; this time was broken up into short sessions because the children's attention span was short. Their early work was hampered by the principal's ruling that any equipment should be removable to avoid vandalism. However they obtained a large truck tire which they filled with sand to make a sandbox. This was stolen very quickly but was recovered through the children's efforts. Rain throughout the winter limited the use of the sandbox; however, enlisting the help of the principal and the Community School Supervisor, they obtained permission from the appropriate authorities to design and build new equipment for the playground.

We had a real problem in our school as neither the kindergarten playcourt nor the larger school playground had any equipment at all. Our playcourt had hopscotch lines and a large circle painted on it, but otherwise was bare. In the first week of school I had the class gather around me while I told them of this problem. I asked them what they would like to have in the playcourt, and everyone talked at once, suggesting a mountain to climb, a thing to roll with your feet, a corkscrew slide, swings, a merry-go-round, a teeter-totter, sand, and a swimming pool. When I asked how we could get these things, there was a dead silence; so I suggested we all think about it and talk about our problem at home.

At our next session no one really had any new ideas although most felt that a swimming pool would be too big. I suggested that a few members of the kindergarten class go to ask the first grade what equipment they would like on the

*Edited by USMES staff

playcourt, and the children thought this was a good idea. However, when the three children got to the first grade room they froze and could not talk, and I had to help them by asking. As it happened, the first graders didn't have any ideas either, and we decided to discuss our problem with the principal instead. Two children arranged for him to talk with us the next week.

When the principal came, he explained that any equipment would have to be removable because he was afraid of vandalism and didn't want to attract children to the playcourt in the summer. He also told us that there was no money available to buy equipment and that we would have to make it ourselves, a circumstance that eliminated many of our ideas.

For a week we did no more about our playcourt until a child asked if he could play with an old automobile tire that was in the closet at school. This set me to thinking about things we could make with tires, and I suggested we try to make a sandbox out of an old truck tire. The children liked this idea, and two boys thought their fathers could get us old tires. One father offered to get one if we could tell him the size, and so we all went outside to see where the sandbox would go and how big it would be. We decided on a spot that would be free of puddles and not too near the classroom so that sand would not be tracked in. Next, we had the problem of measuring the size; two children got a jump rope and decided the playcourt was "five jump ropes" wide and the sand area "one jump rope" wide. As no one thought of converting this to standard measures, we asked the father for a tire one jump rope wide.

It took a couple of weeks for the tire to arrive, and in the meantime we discussed where to get sand. The children immediately suggested the beach, and we discussed the problem of salt from the sand getting on the grass and plants just over the fence. This worried them, and I offered to get sand from the Columbia River instead.

When the tire finally arrived the children at once started playing with it, and then we all helped wash it outside. During the day, the children told the librarian all about the tire. In response she asked them questions about the size of the tire. The children showed her with their hands.

The tire stayed in the classroom for a few days because of rain, and the children enjoyed playing with it inside. As soon as the sun shone, one girl asked where the sand was. I explained that we couldn't get the sand yet because wet sand would be too heavy. As it was election day in our

area, and as the children had visited the polls, we decided to have a vote on how to use the tire. They could vote either to leave the tire inside or to put it outside with sand in it. It took quite a while before everyone understood they could vote only once, and the hands were properly counted by three of our better counters. The final result was twenty-three in favor of taking the tire outside for a sandbox and four in favor of leaving it inside. We decided that there was a majority in favor of using the tire outside as a sandbox.

The children were still very interested in the challenge despite being frustrated by the rain. One quiet boy had talked to his parents about it, and his mother came to say they were getting a book about building playground equipment that they would share with me.

At last the weather was fine enough for me to collect river sand with a helper. When the truck arrived at the school with the boxes of sand, the children were very excited, and all helped unload the boxes and tip the sand into the tire. When the tire was full, we discussed taking turns since the tire wasn't big enough for everyone to play at once. The class chose six children to try it first and they promised not to throw the sand. Our tire was a great success!

We arrived at school the next Monday morning to find sand scattered all over the playcourt and the tire gone. The children were very upset, and two of them said they had seen people taking the tire away. Two children went to ask the custodian, but he knew nothing about it. Two more went to ask the principal, but they also drew a blank. We next wrote a note and sent it around to all the classrooms, asking each teacher to read it to his or her class. In the sixth-classroom one boy said he had found our tire in the street and put it in his yard. He returned it to us that afternoon. The children were delighted to have the tire back, and our experience was the starting point for a discussion about taking other people's property and preventing theft.

As soon as the rain stopped, the children were out in the yard playing with the sand scattered over the playcourt. The tire was also being well-used indoors--for a space craft, a race-track for cars, a place to curl up in, and many other uses. The children urged me to talk again to the principal about equipment for the playground. While he agreed that we needed equipment to help strengthen the children's arms and upper bodies, he had no helpful suggestions to make.

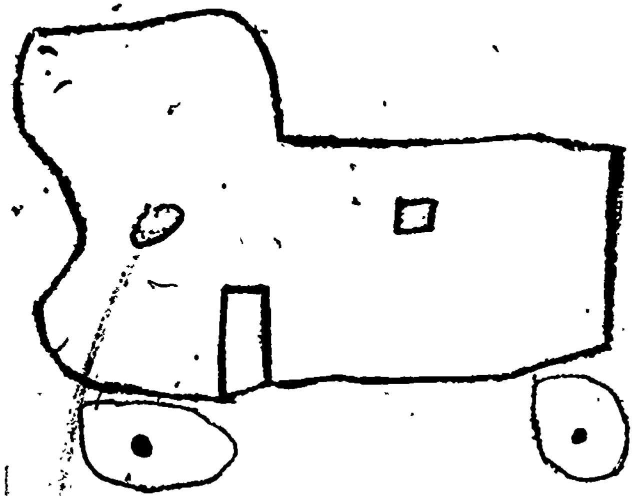


Figure C1-1

When the rain seemed to have set in for the winter, we discussed what we could do inside our room. We investigated the Design Lab to see what we would be able to do there, and the children suggested making things such as airplanes, cars, garages, a doll house, and doll furniture. Another suggestion was to rearrange our classroom to make the indoor play area more interesting. However, after a lot of furniture moving we ended up with an arrangement very similar to the original one.

After the Christmas vacation we started making cars out of pine boards. Each child drew a car on a board and colored it, then took it to the Design Lab to cut out. One child's drawing can be seen in Figure C1-1. There we had assistance from an USMES advisor who helped each child in turn to cut out his or her car. The children could hardly stand the excitement as they waited for their turn to go to the Design Lab. When the cars were cut out, they did, luckily, stand up properly. The children soon noticed they were colored only on one side and set out to rectify this. They were very proud of their work.

While this work was in progress, the Community School Supervisor came to our room to tell us she had seen the work of a San Francisco architect and was willing to pay him from Community School funds to design a playground for us. The playground would be used both by us and by the Community School program in the summer. She hoped that we would get community help and materials donated to build whatever was planned. The class had listened to all this spellbound! We could hardly believe this was happening. While we were waiting for more news about the playcourt, we discussed the possibility of having trees to shade the area in the summer, perhaps bushy trees in pots that could be moved. This would prevent tree climbing with its possible accidents.

Meanwhile, our principal was discussing the possibility of improving the playground with the School Superintendent, and the Community School Supervisor visited the City Planning Commission. They agreed to provide an architect and landscaping person to help us and needed to know the exact measurements of the playcourt. Five jump ropes wide wasn't good enough! One boy suggested using a ruler, and another said his father used a longer stick. As the Community School Supervisor didn't have much time, she suggested borrowing a ten-foot tape measure from the custodian. Unfortunately, it was pouring rain, and the children had to watch from the window while she and I measured the area.

The next news was that the School Superintendent had agreed that we could proceed with our plans because the Community School was involved in addition to our class. Consequently, we planned to take the children to visit other playgrounds in the Portland area to help get ideas for our playcourt.

There was a long delay while waiting for action from the School Superintendent and the Portland Development Commission, and the children got very discouraged.* They talked about putting the tire back outside so that they would at least have sand to play in because by now it was March and the weather was improving. However, they were still hoping for instant results from their ally, the Community School Supervisor, and were not very enthusiastic about the tire.

It was the middle of April when we finally got permission from the authorities to go ahead with our plans for the playcourt. The children were very excited (and so was I), but they didn't realize yet that it would take at least until the fall before the results of our work appeared on the playcourt.

Once the principal received permission from the appropriate authorities, he invited someone from the Office of School District Properties to meet with the class. The Community School Supervisor, as well as two people from the Portland Development Commission, joined us for the meeting.

The principal began by explaining the children's Play Area Design and Use challenge and bringing our visitors up-to-date on what we had done. One of the representatives from the Development Commission, having looked at pictures of the existing playcourt, suggested that we landscape the entire entrance of the building along with the playcourt. He suggested that we think of ideas to accomplish this.

The children and I spent several days in brainstorming sessions. Asking them, "What if...," was enough to get discussion going. One child continued to push his request for a swimming pool but was unable to get much support from his classmates. We pretended that we could make whatever changes we wanted to make. The children decided to--

1. remove an existing fence
2. move shrubs
3. incorporate part of the parking lot into the playcourt

*The children might discuss different types of playground equipment and try to find out which types were the most popular with kindergarten children.--ED.

4. build walls on two sides of an existing covered area
5. plant trees and flowers

Together we prepared a plan of our proposed playcourt, as shown in Figure C1-2, to present to the committee, who would make the decision.

Later in the week we again met with the committee and presented our plan. We were complimented on our thoughtful planning. The representative from the Office of School District Properties could see no reason why the fences could not be removed and also authorized the removal of six parking spaces! He agreed to consider everything we had planned with the stipulation that the necessary materials be available. Members of the Portland Development Commission agreed to coordinate the landscaping with the play equipment when we were ready. We closed the meeting by formulating the following plan:

1. I would list the good things I'd seen in playgrounds I have visited.
2. We would be furnished with names of other playgrounds to visit.
3. Based on visits by me to those places, I would choose a route for a bus (paid for by the Community School budget) so that the kindergarten children could try out various pieces of equipment.

The morning kindergarten class decided to invite the afternoon kindergarten class to join them on their bus tour. I had decided to spend the entire trip at one "super" park rather than waste any time traveling from site to site. Several representatives from the Community School Office joined us for the trip--they wanted to observe the children using different pieces of equipment. Representatives from the Design Center talked with children at the end of their playtime to determine their preferences.

Another field trip using private cars and parents as supervisors was held a short time later. At that time, we visited several other locations to try out different pieces of equipment. This was followed by a meeting with parents to talk about our ideas and look at slides of other playgrounds. Based on the information collected and the ideas of the children, a dome-shaped construction was to be built during the summer; additional plans were to be drawn up in the fall for the playcourt and landscaping.

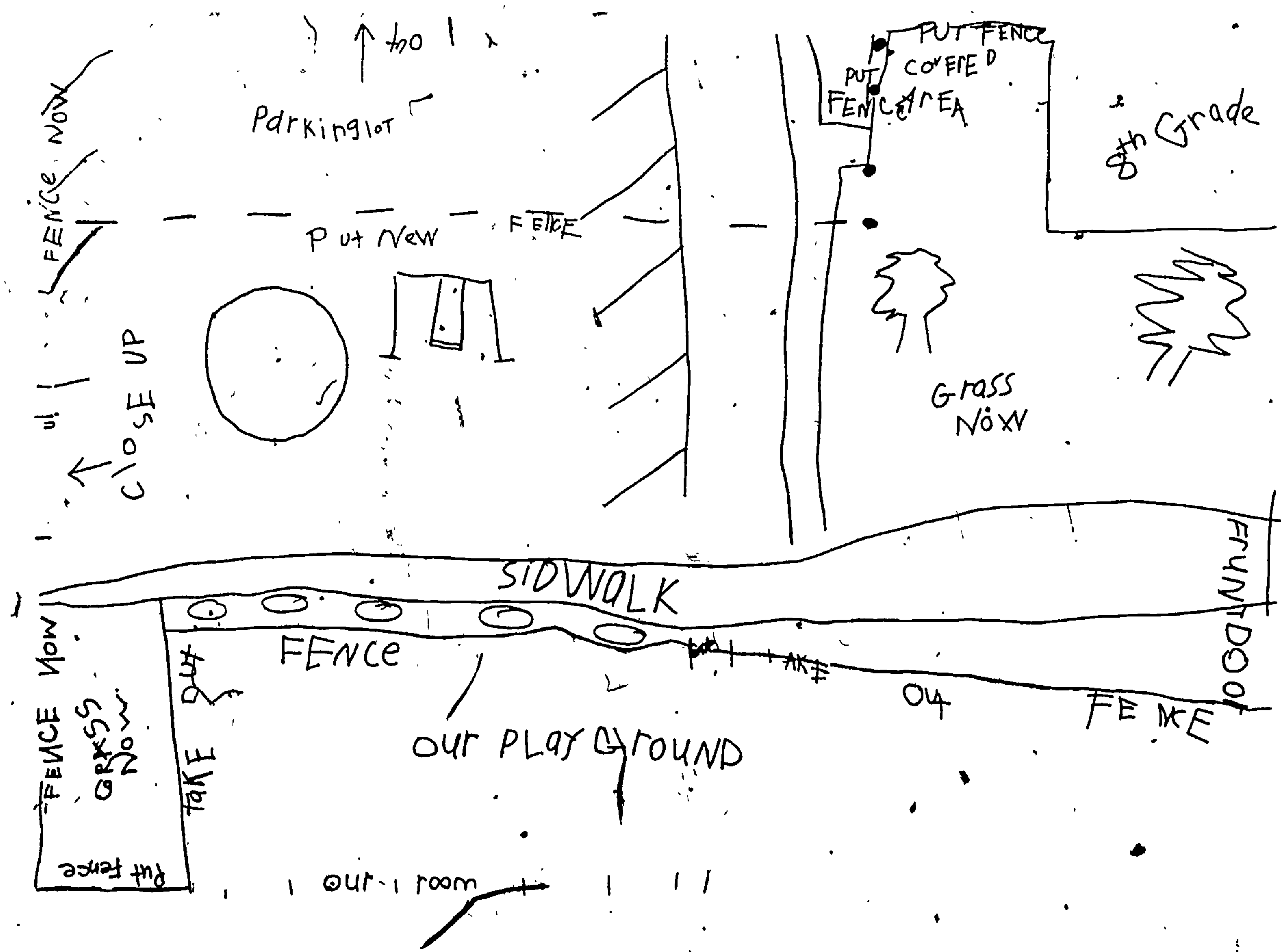
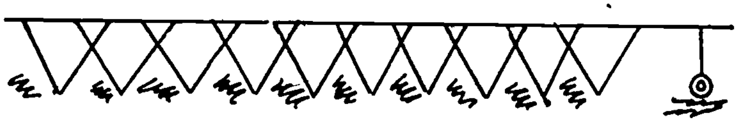

Parkinglot
8th Grade
Put New FENCE
FENCE NOW
CLOSE UP
Grass Now
SIDWALK
FENCE
FRUNTDOOR
our PLAyGround
FENCE NOW
GRASS NOW
our room
Put fence

Figure C1-2

I explained to my children that the project could not be done by the time the school year was over. I promised them that I would explain their project to their teacher in the fall and ask that they be allowed to complete their project next year. They were excited at the prospect of continuing investigations in the fall.

Late in the fall of 1975 I met with the architect who presented his plans in a series of models built to scale and in drawings. The architect did a wonderful job incorporating, within our limited area, all of the things that the children had been enthusiastic about on their visit to another playground.

The plans called for a series of W forms bolted together with only the bottom of the W secured to the ground. Barkdust was to be placed under possible climbing places as well as under the tire swing to be placed at one end. (See sketch below.)



Within the forms were to be platforms, bridges, tubes, ropes for climbing, etc. The project was divided in three phases: Phase I--equipment construction, Phase II--fencing, and Phase III--landscaping.

Later in the year a meeting was arranged between the children who had worked on the challenge the year before, the architect, my present class, and myself. During the meeting the children examined the scale model (each half inch representing one foot) and listened as the plans were explained. The children were very pleased and wanted only to know when they could play on their playcourt.

2. LOG ON PLAY AREA DESIGN AND USE

by Jeanette Lea*
Park View Elementary School, Grade 5
Washington, DC
(December 1972-June 1973)

ABSTRACT

As these fifth-grade students began their investigations of the challenge, they sketched and then discussed their ideas of good playgrounds. The children identified inadequate facilities for primary-grade children as one problem of their playground. They observed the younger children's play area at lunch time and tallied the number of children using the equipment. In order to determine what fractional part of the enrollment this was, they tallied the number of students in all kindergarten through third-grade classes. Mid-way through the school year, $2,000 was allocated for the improvement of the playground. The principal asked these children to make recommendations on how the funds should be spent. Three groups of children worked simultaneously on the graphical representation of data, equipment selection, and model building. Younger students were interviewed for their ideas and were later surveyed to determine their equipment preferences. The children constructed a scale model of the school and playground, visited another play area, and held a play area clean-up day. Based on the recommendations of the students, the principal placed an order for play equipment valued at $2,000 which was later delivered and installed.

In December I first asked my fifth graders for their thoughts on our present play area facilities. I wondered whether they were content with the play area as it presently was, or whether they could think of ways in which it could be improved.

Several of my students mentioned that *real* play area equipment was needed on "the small playground" used by children in kindergarten through second grade. (Park View school provides two play areas for the students: the "small play-

*Edited by USMES staff

ground" that is used by the children in primary grades, the other is for the children in intermediate grades.) One child elaborated on the problems with the primary-grade play area. She noted that the little children had only two slides and a set of monkey bars in their area, adding that because there was not enough equipment for everyone, many little ones were coming over to the "big kids'" apparatus. This, she felt, was dangerous.

I then told her and the rest of my class that we might be able to spend some time each week on this problem if they were really interested in finding a solution. Everyone seemed intrigued with this possibility, and so we spent some time discussing various aspects of the problem. Before the session ended the children sketched what each considered might be "a good playground."

When we gathered again to discuss the small playground problem, we first talked about each of our drawings, commenting on the equipment drawn and getting some good ideas for our own design plan. I then asked my students what the little children liked to do on the present play area. "Did they climb on the monkey bars? Might they want more swings?"

Several children volunteered to observe the children playing outside. They suggested watching them between 12:00 and 1:15, a time when the children who did not go home for lunch used the area. The group said that they would report their observations to the class.

When the observers returned, they had data on the number of children using each piece of equipment in the small play area. They said that this information would tell them which pieces were popular and how much new equipment might be needed. Their data was as follows:

Slide #1	50 children
Slide #2	68 children
Monkey Bars	8 children
Total	126 children

This information made me wonder about several things which I discussed with the class. "Why were there so few people on the monkey bars?" I asked.

"Because they are too high," responded one child.

"Oh, that might be something to keep in mind when you design your playground improvements," I pointed out. I continued by raising the question, "Is it possible that 126 children could be using the equipment at once? How many students are in the kindergarten and the first and second grades?"

The need to answer the last question immediately involved the children in a new venture. No one knew how many students were in the three grades, but four children volunteered to find out. For several minutes we talked about ways to keep track of the counts for each class in each grade. One student discovered the USMES "How To" Card on tallying; he and a classmate opted to tally the number of students. The other two members of the group assured me that they could remember the number of students long enough to write it down on paper. The group then dispersed to visit the various classrooms.

During the next USMES session, the counters shared the information they had gathered with their classmates. One child's tally can be seen in Figure C2-1. As a class, we totalled the number of students in each grade; we did this first in our heads and then on paper:

Kindergarten	47 children
First grade	106 children
Second grade	112 children
Total	265 children

We then compared this figure, 265, to our tally of 126 children using the small playground during lunch. I asked the children, "If there were 265 children who could be on the playground, is it then possible that 126 were on it during lunch?"

"Yes," was the response.

"What else do we need to know? One hundred and twenty-six were on the playground during lunch; where did all the other children go?" I queried.

One child said, "Some go home to lunch."

"Maybe we should know how many go home and how many stay," I stated.

"Some kids go to another playground," announced another student.

I questioned, "Can we blame them for going?"

"No," responded the same student, "there's nothing else to play on."

"Yes," I agreed, "but it's against the rules. Why don't we want kids on that playground?"

A child who had not participated in this discussion answered, "They'll get hurt. The equipment is big. And the street is dangerous."

"Well, what can we do about it?" I asked.

"Fix our playground so they'll want to stay here," stated another child.

Recalling one of my early questions, I suggested that we try to find out how many children did stay at school for lunch. Two children volunteered to get that information for us.*

Name of teachers	Tally marks	Totals
First Grades:		
1 Sherrill	卌 卌 卌 卌 卌 |||	28
2 Bostick	卌 卌 卌 卌 卌	25
3 McClurkin	卌 卌 卌 卌 卌 ||	27
4 Marrutte	卌 卌 卌 卌 卌 |	26
Second Grades		
1 Johnson	卌 卌 卌 卌 卌 ||||	29
2 Wilson	卌 卌 卌 卌 卌 |	26
3 Brown	卌 卌 卌 卌 卌 |	26
4 Paschall	卌 卌 卌 卌 卌 |||	28
Kindergarten		
1 Emma	卌 卌 卌 卌 卌	25
2 Landers	卌 卌 卌 卌 ||	22

Figure C2-1

After Christmas vacation, I told my class that the principal of Park View had agreed to allocate $2,000 in the school budget for us to use for playground improvements. I explained that she had been very excited by our plans to fix up the small area and related to the class that they would be responsible for using the money to purchase and/or build new pieces of equipment. The reality of actually effecting a change at Park View really struck my students. They were thrilled by their challenge and became more serious about

*No data on their findings was included in the teacher's log. ---ED.

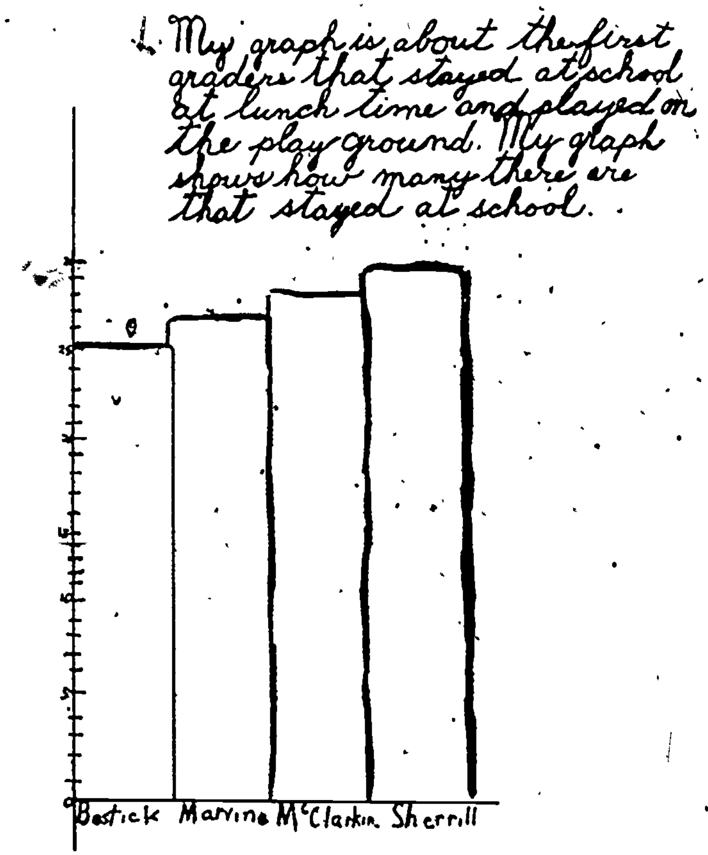


Figure C2-2

their project as if aware of the enormous responsibility which was now theirs.

We split into three groups to work on various aspects of the challenge. For the rest of January and February, the children worked on graphing, equipment selection, and model building as described below.

Graph Group

I suggested to the class that one group of children might be responsible for collecting all of our accumulated information and putting it on a chart. One child proposed that we make a bar graph of our data. I was surprised that the notion had occurred to him and asked whether he knew how to make a bar graph. Because he expressed a dubious yes, he and I gathered a small number of children together to help him make bar graphs. I referred the group to the set of "How To" Cards on bar graphs and suggested that they try using them. I later noticed that the children were having some difficulties with the cards and their graphs, so we worked together on them until most of their confusion was cleared up.

In March, the graphers showed me the outcome of their adventure with bar graphs and "How To" Cards. An example of one of their bar graphs can be seen in Figure C2-2--it depicts the number of children in each first-grade class. Other group members graphed the sizes of the kindergarten and second-grade classes. Some of the children in the group said that they also intended to make graphs of the number of boys and girls in each grade level.

Equipment Group

Several children told me that they wished to pick out new equipment for the playground. I gave them catalogs containing pictures of many play apparatuses and suggested that the books be scanned for design ideas.

Initially, the boys did not want to share ideas and make plans with the girls; so two groups were formed to work out separate designs. The boys immediately began to look for action-oriented equipment--baseball backstops, high slides, etc. The girls selected equipment pieces that permitted quiet activities--sandboxes, a shelter.*

*The children might compare the number of children who can use each piece of equipment with the area each piece takes up. See "How To" Cards on slope diagrams.--ED.

Odie Hall Jaunay 4, 1973

pipe crawl 160
sand box - 120
sand box - 120
see saw - 80
pole climb - 60
swing set 250
swing set 250
merry-go - 110
slide - 150
slide - 150
ladders - 100
gym set 100
~~monkey pole 150~~
~~see saw 80~~
$1,990*

This shows what I want the children to have, so I think they will enjoy this. I had $2000 to spend.

Figure C2-3

As they had only one playground to design, I suggested that the two groups combine and try to resolve the differences between their design plans. This they did. However, when I visited the group later, I found each group member compiling his/her own list of equipment pieces and their costs--each child had wanted to spend the $2,000 in his/her own way.

I noticed that some people were having difficulty with decimal notation. We first figured out several ways to write an amount of money, for example $250, and then tried to add some prices together making sure that we lined up the decimals correctly. As the concept became clear to individuals, they went back to compiling equipment lists and making price calculations. One child's work can be seen in Figure C2-3.

In March, when the individual lists were finished, the group talked with the rest of the class about a fair way to choose between each person's suggestions. I suggested that it might be helpful to investigate the ideas that the primary children had about their playground. One boy proposed that we make posters of our equipment designs and have the younger children vote on them. A few students liked that idea and went off with him to sketch various pieces of equipment. One girl wondered whether it might be also good to talk with the younger children to get their ideas. She subsequently found several people who were willing to help her interview the lower-grade children.

The children working on posters spent several weeks making their drawings. By the beginning of April, they had made pictures of, among other things, a crawl pipe and a slide from a big tower. The committee then deliberated over ways to survey the primary children. Some committee members wanted to let each voting child choose as many designs as he or she liked; other members wished to allow votes only for the top choice. After some discussion, the group decided to list all equipment choices on a ballot and ask the voters to place an "X" next to their first preference.

During March and April, the group of interviewers arranged to meet with small groups of children from the three lower grades. Each group was asked for their ideas for new playground equipment. The interviewers kept a record of their suggestions, which included swings, merry-go-round,

*Cost might also be compared to possible usage. See previous footnote and Background Papers on comparing ratios by making slope diagrams. A mistake was made in adding the costs; the correct total should be $1920.--ED.

sandbox, and bump cars. The group planned to include these pieces on the ballot listings.

The Model Builders

The boys and girls in this group wanted to make a three-dimensional model of the school building and the small play-ground including all presently available equipment. They first decided to make a rough sketch of the school buildings and grounds to make sure that their model was accurate. They spent several days outside noting the shape of the school and its environs. Using their rough drawing, the group began their model. For building materials they used squares, rectangles, and circles made out of wood.

Several children who were not in the group interrupted the construction activities: they contended that the block replica of the small play area was the wrong shape. I asked one boy how he might check the accuracy of the model. After a lengthy pause, he said that we might measure the area. I agreed (heartily) with his idea, and we arranged to spend several days obtaining measurements of the play area.

As I thought that the whole class might benefit from this measuring activity, I asked all of my students to participate in gathering the necessary measurements. We went outside, and I suggested that it might be wise if we first experimented with measuring only a small part of the playground. I specified the area; my students chose various measuring tools (tape measures, rulers, and yardsticks) and went off to determine the size of that area. When these measurements were completed, some people decided to spend the rest of the period investigating the location and condition of the present play facilities.

The next day, we returned to the play area. This time, I asked the children first to make sketches of the small play area. When they had finished their drawings, we discussed what measuring procedures we should follow. I asked the children, "What shape does the small play area represent?"

"A square," replied one boy.

"Are you sure?" I questioned. "Are all the sides equal?"

"Oh," he replied after reconsidering his first answer, "a rectangle."

"Okay, what does that mean about our measuring--we have to measure more than one side, right?" I then asked, "Why don't you label the end of one side of the rectangle A and the other B, and then measure the distance between A and B?"

The children oriented their drawings and themselves to

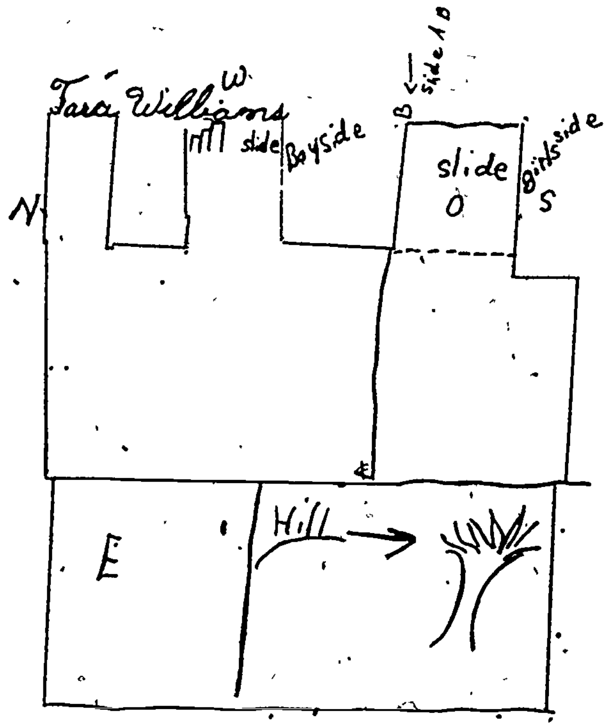


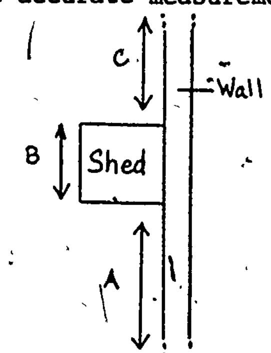
Figure C2-4

determine which side of their rectangular sketches represented which edge of their play area. Using tape measures, string, and their own feet, among other things, they subsequently measured the length A to B. One child's drawing which indicates that length can be seen in Figure C2-4.

A discrepancy was found between the measurements of two students. One child questioned whether their findings were the same because they were expressed in different units of measurement. In Figure C2-5 she describes how she compared her results using a yardstick with those of her classmate who used a five-foot tape measure.*

The following day, we all returned to the small play area to take the necessary measurements. Different groups of about five or six children each dispersed to measure different parts of the playground. The group collected data in their own area and assigned each member the responsibility of determining the size of one part of that area. Each group of children seemed very concerned about accuracy; as each measurement was determined, it was recorded on one member's diagram of the play area.

One group soon was confronted with an obstacle: a tool shed was built against one side of the play area. The children did not know how they could measure the wall with the shed in the way. For a while we pondered possible ways to overcome this problem. Someone pointed out that the front length of the tool shed was probably the same length as that part of the wall which was obstructed. The kids decided that they could measure along the wall up to the shed (A), then along the front length (B), and finally back along the wall (C) to obtain an accurate measurement of the wall size.



*Despite her ingenuity, the measurements are not equal. She measured 32 yards, 18 inches which is 1170 inches while he measured 696 inches.--ED.

I measured side R-B on the play ground to see what was the length. I found the length to be 32 yards 18 inch

My Classmate, Raymond, measur[ed] the same distance (side RB) in inch. He found that the side was 69 inches

I wanted to find if our measures compared with each other. This is what I did.

Raymond's		Winifred 32 yd 18 in	
60 →	1 yd. 24 in	36	
60	1 yd. 24 in.	11	
60	1 yd 24	36	
60	1 yd 24	36	
60	1 yd 24	396 inch	
60	1 yd. 24		
60	1 yd 24	24	
60	1 yd. 24	×11	264 inches
60	1 yd. 24	24	396
60	1 yd 24	24	+ 32
692 in.	1 — 32	264 inch.	692 inches

I proved that Raymond's inches is equal to my yards.

Figure C2-5

When we had finished measuring the areas, we went back to the classroom to compare our findings with the dimensions of the block replica. As there were no more blocks, we decided to make a two-dimensional scale diagram of the play area out of construction paper.

Since finding an appropriate scale for our model appeared to be an arduous endeavor, we worked on the problems of unit conversion as a class. We first confronted the concept of drawing to scale by talking about the scale of a roadmap which was familiar to everyone. Given a scale in which 1 inch ↔ 500 miles, each child worked out how many miles would be represented by 2 inches. We then tried a scale of 1 1/4 inch ↔ 500 miles, and I asked the children, "How many miles did 2 1/2 inches stand for?" Since the children had some difficulty working with the fraction, I backtracked a little and asked, "If 1 1/4 inches represents 500 miles, 2 1/2 inches represents what?"

One student went to the board and wrote 1 1/4 + 1 1/4 = 2 2/4. I questioned whether or not that was *totally* right. "What's another name for two-fourths?"

The child responded, "Four-eighths."

"Okay," I continued, "what about a lower name for it?"

He answered, "One-half."

"That's right," I agreed. "So 2 2/4 equals 2 1/2. Then 2 1/2 represents how many miles?" (silence) "What have I done if I add two plus two and get four?"

"Added them," was the answer.

"What else?" I queried.

"Doubled two," responded another child.

I then asked, "Okay, what have I done if I add 1 1/4 and 1 1/4 and come out with 2 1/2?"

"Doubled it," spoke one child.

"If 2 inches ↔ 4 meters, 4 inches ↔ 8 meters, 8 inches ↔ 16 meters, . . ." I said.

"You've doubled them," noted a student.

"Oh, so 2 1/2 inches means 1,000 miles," continued one child.

"Okay," I said, "good."

I then asked them to figure out at their desks how many miles 4 1/2 inches stood for, using a scale of 1 1/4 inches ↔ 500 miles. As they worked on the problem, I helped some of those people who were still puzzled by the scaling concept. It seemed that the notion of the correspondence between actual dimensions and diagrammed dimensions was difficult to grasp; many people also found working with the fractions difficult.

During the next class we moved from the mechanics of conversion to actually making a scale drawing. I suggested that we first try to make a scale drawing of our desks. "Let's find a scale for our desks. They are, say, twenty-four inches long and eighteen inches wide. You decide what a good scale should be."

"One inch equals one inch won't work--won't even fit on our paper!" said one boy.

"Two inches equals one is still too big!" added one girl.

A third student excitedly said, "Three inches works!"

"Or you could make it smaller..." another girl countered,

"Good," I said. "Why don't you now figure out your own scales? Make them different from those that have already been mentioned."

I made the "How To" Cards on scaling available for those who wanted to use them. The class worked on their scale drawing for the next several days.

Before we could begin on our models of the school or the play area, the opportunity arose for us to visit one of the local playgrounds. After we returned from our trip, the children were more eager than ever to see some changes made in the play area. As it did not appear that we would be able to build equipment this year, I proposed that we apply our Johnny Horizon Program (Let's Clean Up America) to our play area project. The class thought that my idea was very good; boys quickly volunteered to bring brooms and garbage bags. The clean-up was scheduled for May 4.

Our clean-up day arrived; the children were eager to begin. We debated over whether or not we should divide into work crews and assign specific responsibilities to each group. As that idea evoked considerable disapproval, we decided to just work together, doing whatever jobs appeared to need doing. The yard was heaped with sticks, broken glass, paper and other objects. These were quickly swept into piles and dumped into large garbage bags. With the help of so many hands--and a few songs--we finished cleaning the play area in a surprisingly short time.

During the final weeks of the school year the children continued their group work. The Equipment Committee said that they wanted to write to companies about the use of old buses and fire engines for playground equipment. For the younger children they compiled a list of possible games that might be put on the blacktop area of our small playground. The following play equipment was ordered at a cost of $2,000:

1. swings
2. merry-go-round
3. two slides
4. trash cans

The school year ended and my fifth-grade students graduated before the equipment arrived. In September of 1974 the equipment was delivered. Although installation had to be delayed until funds could be located to cover the installation costs, the equipment was finally set up.

Now children in the primary grades at the Park View Elementary School are enjoying the results of the work of my class on the Play Area Design and Use challenge. I spoke with most of the students who worked on the challenge to let them know that their efforts were not in vain--they were delighted.

3. LOG ON PLAY AREA DESIGN AND USE

by James Brown*
Shapleigh Memorial School, Grade 5
Shapleigh, Maine
(September 1975-April 1976)

ABSTRACT

These fifth-grade students were challenged to improve the quality of their play area. They spent one and one-half hours each day for three months working on their Play Area Design and Use challenge. Additional time was spent daily on challenge-related or "inspired" activities as real problem solving became their curriculum. Due to budget limitations and the need for more equipment, the children focused on the design and construction of play equipment. To insure that the new additions be appropriate in size, the children measured the play area and all of their schoolmates, graphed their data, and analyzed their results before making final decisions on the types and sizes of new equipment. Comparative shopping was done before materials were purchased. Finally, the equipment was constructed and installed.

The Play Area Design and Use challenge that became our focus of activity emerged naturally from my class of twenty-six students--seventeen boys and nine girls--during a class discussion of school problems. A large number of youngsters had become disgruntled with their playground activities. The boys enjoyed football, but the girls could find no available focus for their energies. Although they noted that some schoolmates did use the swings, chinning bars, and walk ladder already on the play space, the children felt strongly that the number and range of possible play area activities was too small to meet the needs of the schools' 113 students. Consequently, when the complaining began, I challenged them to improve their play area.

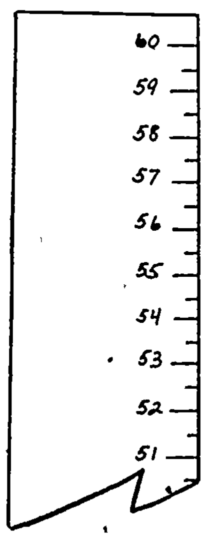
The children's initial response to the problem was to order additional play equipment. Due to budget restrictions this expenditure had to be limited to $150. The students quickly glanced through "conveniently" placed equipment catalogs in the classroom and noted that the costs were prohibitive. Several youngsters suggested that they make their own equipment, an idea that was very well received. The remainder of this first class session was spent discussing what was presently on the playground and what they would like to add to it.

*Edited by USMES staff

The next day, we reviewed the previous day's discussion and focused on "Things to Consider" or "Problems to be Faced." The dialogue of this period established the direction to be followed during the next weeks.

The first problem to be considered was "How big should the apparatus be?" The students decided that in order to answer that question they would have to take measurements of the children who would use the equipment. After much discussion the students decided to collect data on user height, weight, hip width, arm length, and leg length. Five groups were formed and each took responsibility for measuring students in a certain number of classes.

Before the data collection process began, I held a skill session on using measuring instruments. Some children's experiences with rulers was limited to drawing straight lines. Together we practiced measuring different items with a ruler, learning about fractional parts of an inch, and weighing things on a scale. The children measured a variety of objects in the room to the nearest inch, half-inch, quarter-inch, eighth-inch, and sixteenth-inch. These measurements involved learning about equivalent fractions because the rulers had a varying range of markings. For example, the children began to see that a desk 23 6/8 inches wide was the same width as a desk 23 3/4 inches wide or one 23 12/16 inches wide. Wall charts, such as the portion of one sketched below, were constructed for measuring heights.



Letters asking for permission to use class time for measuring were written by each group and delivered to the teachers. When the students received permission, they developed a schedule and took the measurements.

The next day a reporting session was held. During this time some of the children pointed out that different groups had taken measurements differently. For example, some measured student height with shoes on while others measured height with shoes off; some groups rounded off measurements, and others did not. The class agreed that (1) the different standards used invalidated the measurements and (2) a new set of measurements had to be taken with everyone using the same standards and rounding off to the nearest 1/4 inch. The measurements were taken a second time to everyone's satisfaction. The differences in the data collection procedures were so significant that the kindergarten teacher in the school wrote a letter commenting on the change. (See typed excerpts of letter below.)

> *This note is to let you know how impressed I am with the group of students from your class who measured and weighed my students this afternoon. Today's operation showed a good deal of organization and efficient division of labor. What impressed me the most was the flow pattern that was placed on the floor. To me this shows an understanding of the people they were dealing with, the young kindergarten students...*
>
> *In closing I would like to add that I'm pleased to see that your students learned from their initial mistake and devised a new and more successful approach.*

When the second set of measurement data was collected, we met as a class to examine it. A discussion soon developed on ways to represent the data so that other people could easily understand it, and I introduced my students to graphs. We spent five days learning graphing skills and how to use a bar graph, histogram, scatter graph, and line chart. Much discussion followed as to the advantages, disadvantages, and most effective us of each type of graph. After the skills were acquired, each group decided which type of graph to use to plot their measurement data. At some point, every group used the line chart so that they could represent all five sets of data on the same piece of paper.

Later on there was much interpolation from these charts to determine the size of the equipment--how high each should be, how much weight each must be able to accommodate. From the scatter graph of the heights and weights of class members, the students concluded that some of their classmates were underweight and others overweight. This discovery provided the basis for a lively discussion!

Throughout the time my students worked on Play Area Design and Use, each child kept a problem-solving diary for creative writing, English composition, and grammar. Excerpts from one child's diary can be seen in Figure C3-1.

During the next USMES session the children focused on a second question facing them: the size of the playground--where it started and where it ended. Because the boundaries were unclear, we knew neither how large it was nor, consequently, how much space we had for equipment. One girl suggested telephoning the school superintendent to ask for a copy of the deed that contained perimeter measurements.

When the deed arrived, the children examined it carefully. They learned that the school lot covered an area of five acres, more or less. This led to a discussion of area and a skill session on finding perimeter and area and multiplying with two-digit factors. The directions described in the deed and the monuments to which it referred were sufficient for us to determine the unknown markers. Before the session ended, the class discussed different ways to take the necessary measurements of the space. Initial suggestions included tape measures, string, trundle wheels, and protractors.

The next day, two boys spied the USMES "How To" Cards on measuring large distances. Excitedly acting on an idea contained in cards, they each constructed a trundle wheel, one measuring thirty-eight inches around and the other thirty-nine inches. To measure the school grounds, the children used the trundle wheels, yardsticks, tape measures, and premeasured lengths of string. Over the course of the next sessions, many of the youngsters remeasured the space using different devices to determine which one gave the least margin of error.

As their work continued, and they began drawing the playground and its existing equipment (using one-sixteenth of an inch to represent one foot), the children gained a great deal of practice in division and multiplication. Including the location of existing equipment was deemed quite important because no one wanted the use of new and old equipment to interfere with each other.

P1

When our class started USMES, we did the unit, playground designing. Then we ~~had a~~ discussed ~~on~~ what ~~we had~~ was on the playground at the present time. Such as bars, swings and ~~and~~ soccar goals. Then our class had a disscusion on what we would like to have Such as a tether ball, another goal. Then all of us disscused the problems and ones that might come up. Some were; a bar might be to high for somone and to low for another. A problem that might come up would be if we had a maypole and people wouldn't let anybody else get a turn.

over →

P2

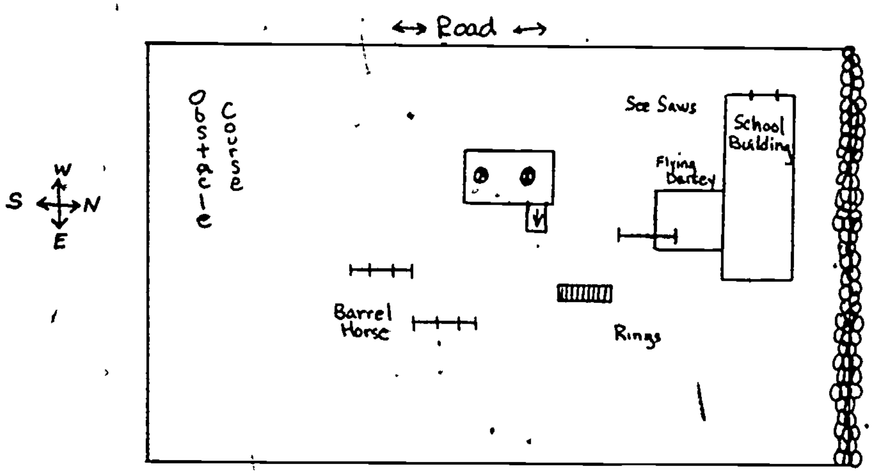
Another problem was what would be safe and useful. 1. If someone got on a bar and it broke it wouldn't be safe. So it would have to be safe and useful. To make the equipment for everybody we had to measure all the classes. Then we made groups and decided who to measure & how. When our group was measuring the kids they had their shoes off. The things that were measured were, hips, legs, arms, height & weight. The weight was measured by scales. The height was with a measuring chart. And the rest was with a measuring tape. Some of the problems were that some wouldn't stay still,

P.3

some would have to be called back up because they forgot something. We had to do it over because we didn't do it with shoes on. We collected all our data and put it on one piece of paper. Then we decided on what kind of graph we would use. Then we graphed it out on a line graph.

Figure C3-1

As the need for additional skills surfaced, we held many skills sessions; for example, determining and using ratios and proportions, fractions, scale drawings, and indirect measurements. A sketch of their scale drawing which took four 1½-hour sessions to complete can be seen below.



Sketch of Scale Drawing of Play Area.

The children's interest at this time extended to the use of indirect measurement. Several sessions were spent making and using range finders. These activities involved the use of proportions to find the diameters of distant objects and the ratios of shadow lengths to determine the heights of tall objects, along with the preparation of scale drawings.

Completing the map of the play area, the students used their measurement data to design equipment that would accommodate all the children at school and would fit within the available playground space. They designed and later constructed the following equipment:

- An adjustable-height "battle horse" made by suspending a fifty-gallon drum from rope attached to four wooden posts. Additional ropes were attached on either end of the drum and a great mound of hay was placed on the ground directly beneath the drum. To use the battle horse, one child tries to sit on the drum for as long as possible while other children, pulling on the ropes extending from each end of the drum, try to dump the rider into the hay.

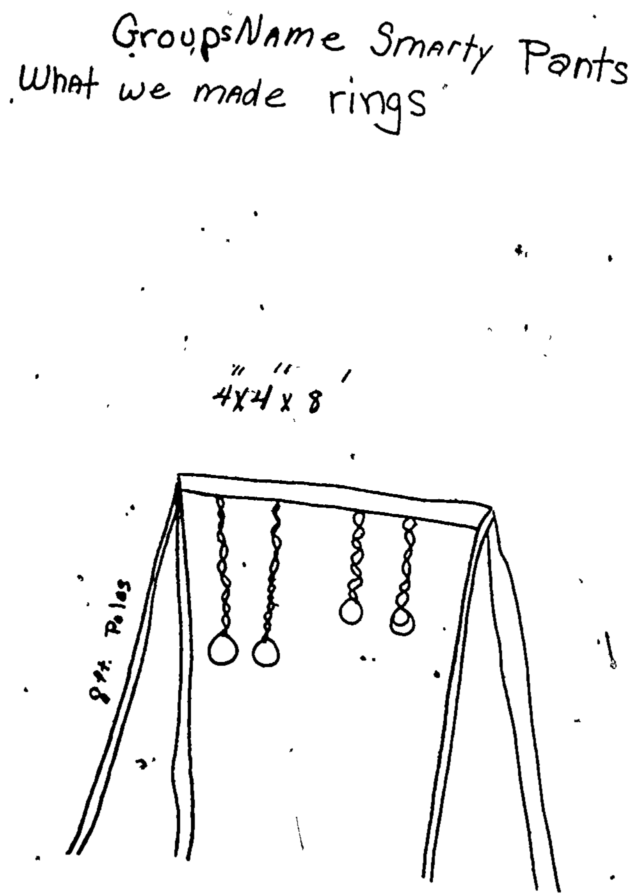


Figure C3-2

- A double seesaw.
- Two swinging trapezes, one for younger children and one for older children.
- A swing.
- An obstacle course containing a tire climb, hurdles, a rope swing, and a barrel tunnel.

The children's first designs were very elaborate and called for welding and pipe-bending. However, after looking at the tools and materials on hand, they modified their plans so that all the equipment could be made from lumber.

The youngsters felt quite insecure about how they would fasten their pieces of lumber together or even how much lumber they should order. They agreed to construct scale models of their plans using pencils, clay, straws, string, and washers. For any equipment on which swinging was involved, they tested for strength by suspending and swinging a 100-gram weight on it. If the model buckled or wobbled, the group then figured out where additional supports were needed or larger stock should be used. From the models, the children determined that a forty-five degree angle had the greatest strength, and they also calculated the size and amount of lumber to order. Copies of their drawings can be seen in Figures C3-2 and C3-3 on the following page.

One of the boys gathered the orders from each of the five groups and went to a lumberyard near his home to find out about prices. He obtained a unit price on all the materials we needed and reported to the class the following day. All groups then computed the total cost of their equipment and figured the sales tax. (Percentage and multiplication of decimals became a separate skill session at this time.) After each group found its cost, we combined five subtotals to determine the grand total for all equipment. Much to our surprise, the total cost of lumber was $145.

The children were flabbergasted by this figure, and one child said, "That's an awful lot, Mr. Brown. Couldn't we get this stuff somewhere else?"

When I responded that I didn't know whether prices would be cheaper anywhere else, one of the boys decided to telephone some other lumberyards in the area. Using the school phone, he immediately called three other suppliers and obtained their unit prices for the same materials. Each group then used these new figures to compute the cost plus sales tax for their constructions. The fourth lumberyard was the place with whom the class chose to do business and for good reason: they were able to buy the needed materials for only $60. That was more than a 50% savings over the first lumberyard.

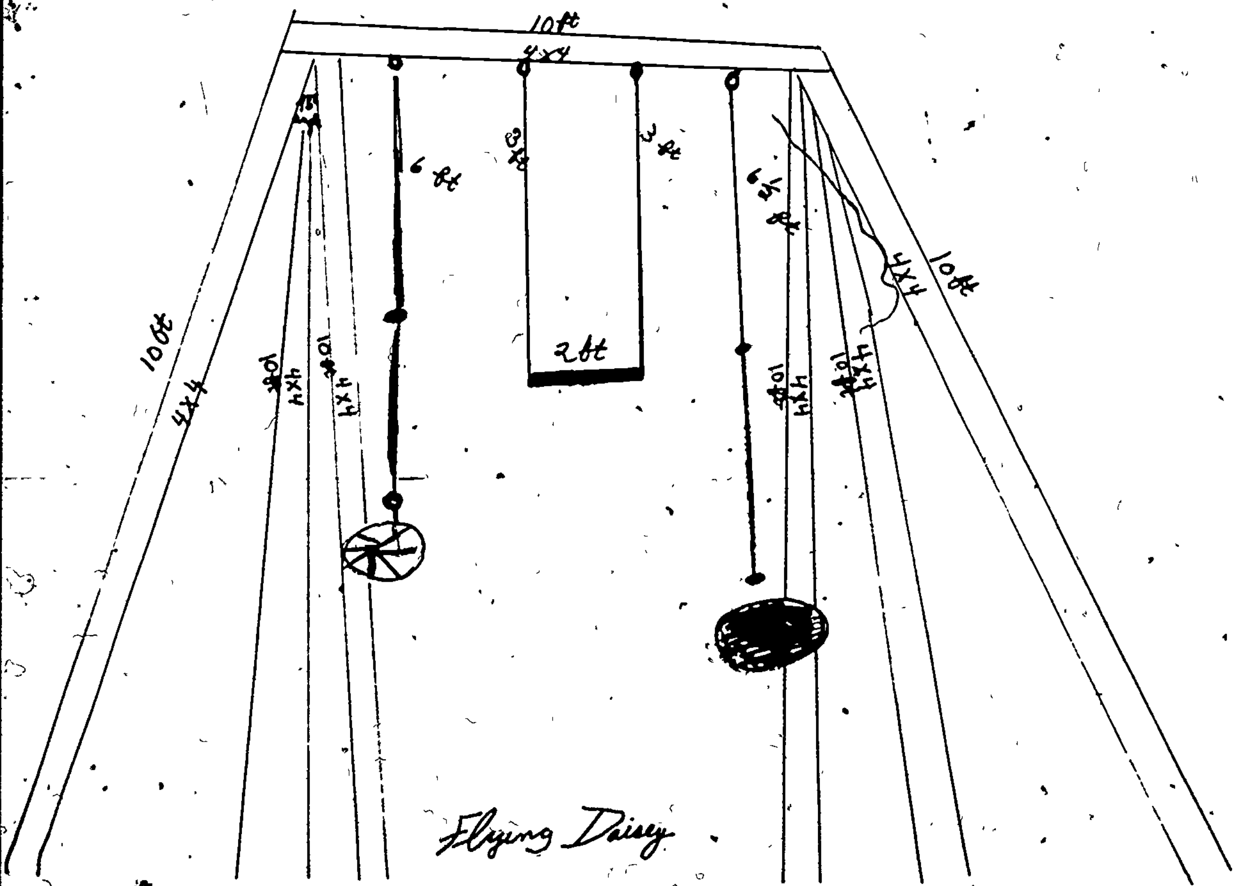


Figure C3-3

Between the time we began the Play Area Design and Use challenge and the time the supplies were delivered, I taught each youngster the "dos" and "don'ts" of our Design Lab equipment, specifically, the use of handsaws, saber saws, hammers, hand drills and power drills, brace and bits, wood chisels, screwdrivers, and block planes.

The supplies were delivered during the first weekend in November, and on the following Monday afternoon, construc-

Roles
Barrel Horse HANDWRITING-2

1. Only one on the barrel at a time.

2. One person pull each rope at a time
Eddie

3. no hanging on the screwbgs.

4. no standing on the barrl
David

5. no climbing on the posts

6. no pulling on the ropes that are attached to the posts
Brad

7. no going inside the four post's when somone is on the Barrel.

8. Don't push or pull the person who is pulling the ropes
Darleen

9 No pushing off barrel.

Figure C3-4

tion was begun. In each group the students divided their labor, shared equipment, and allowed every member to participate in whatever needed to be done. The construction of equipment continued well into December. Some of it was placed temporarily in the ground until the earth froze and snow fell. The class then decided to store their equipment pieces until spring when they cemented the posts in the ground and finished up the remaining details.

During their construction activities, the children learned by trial and error. For example, the ten-foot trapeze was so large that it collapsed while being assembled; the six-inch lag screws that held the 4" x 4" supports together were bent right in half. Not only did the girls who had made it cry, but tears came to my eyes, too. However, some students from another group came to the rescue, consoled the "builders," and helped them repair the broken parts.

After seeing the collapse, another group constructing an eight-foot trapeze for younger children decided to erect theirs in a different manner; they were successful in their attempt. This served to reinforce the idea that many of our greatest successes come from our failures; simply stated, making mistakes can be valuable.

Shortly after a few pieces of apparatus had been erected, a parent telephoned to express her concern about the safety of the equipment. I relayed the message to the class, and one boy resolved the issue after thinking about the problem for a few minutes. He suggested, and all the other children agreed, that rubber tires be cut and attached to the wooden uprights to cushion any impact that might possibly occur. Each group wrote up rules for using their equipment and alternative methods of enforcement if the rules were not followed. The children also decided that rather than asking teachers to supervise activities on their playground equipment, they would assume this responsibility. (See Figure C3-4 for a copy of the rules developed to govern the use of the barrel horse.)

The entire school day of my class was scheduled around real problem solving activities. Time in the morning was devoted to skill development as warranted by the students' activities and needs, while two hours of the afternoons were spent working directly on their challenge. In addition to the problem-solving diary mentioned earlier, even our spelling words were an outgrowth of the children's activities on play area design and use. The focus of social science for my students was socio-dynamics, group dynamics, and group decision making.

Every afternoon the session began with reports from various groups who shared with their classmates the goals for that day. These goals were written on the chalkboard, and then the students continued with their group activities. At the end of the session each group reported on its accomplishments as well as on any problems the members had encountered. Many times the students were surprised to discover that they had exceeded their expectations, while at some times they realized that they hadn't achieved what they set out to do. In the latter case, we tried to determine what had prevented the group from attaining the goals and, as a class, helped them plan an alternative course of action.

Evaluation of the students' work on the Play Area Design and Use challenge was based on each individual's performance during investigations of the challenge and on teacher-designed application tests. Each youngster was always evaluated on what he or she was capable of doing. Much of the ongoing evaluation was a cooperative effort between the students and myself.

The enthusiasm that resulted from their investigations spread quickly to their parents, who, in return responded positively. Many parents visited the school and became actively involved in their youngsters' learning.

As a result of their work on the challenge, the children came to see that skills in all of their subjects--English, science, math, and social science--are essential to everyday living and to solving problems at home, in school, or on the playground. The process of real problem solving was applied to planning a fair to raise money to subsidize their future USMES activities.

4. MINI-LOG ON PLAY AREA DESIGN AND USE
Redesigning Games on the Blacktop Area of the Playground

by Janet Sitter*
Allen Street School, Grades 4-6
Lansing, Michigan
(September 1972-February 1973)

ABSTRACT

This multiage group of fourth, fifth, and sixth graders were challenged to redesign their play area. They spent an average of two sessions per week over a six-month period on Play Area Design and Use activities. One of the areas of concern for the children was the improvement of the blacktop section of their playground. Observations were made, and based on these observations, the children developed plans for painting games on the blacktop area. They devised new games, selected colors for their designs, and wrote up descriptions of their games. Groups of students scrounged paint and built sawhorses to keep schoolmates off the freshly painted areas. Work on the blacktop area was completed, and the area was used by the children in the school.

Shortly after the children in my combination fourth/fifth/sixth-grade class began their investigation of the Play Area Design and Use challenge, someone expressed interest in "doing something" with the blacktop section of the playground. I asked whether we should paint the area or dig it up. One student answered, "We could put more games on it." The others agreed that painting it would be more feasible than digging it up. For the next session I asked them to think about how we could paint it to make it more fun to use. The children had varied reactions to this first discussion: some were very interested and some quite bored, mostly because they did not really believe that we could effect any change.

At the beginning of the second session, four students who were interested in improving the blacktop area went out to the playground to prepare lists and drawings of games we presently had. While they were outside, I showed some bright, multicolored art designs to give the remaining stu-

*Edited by USMES staff

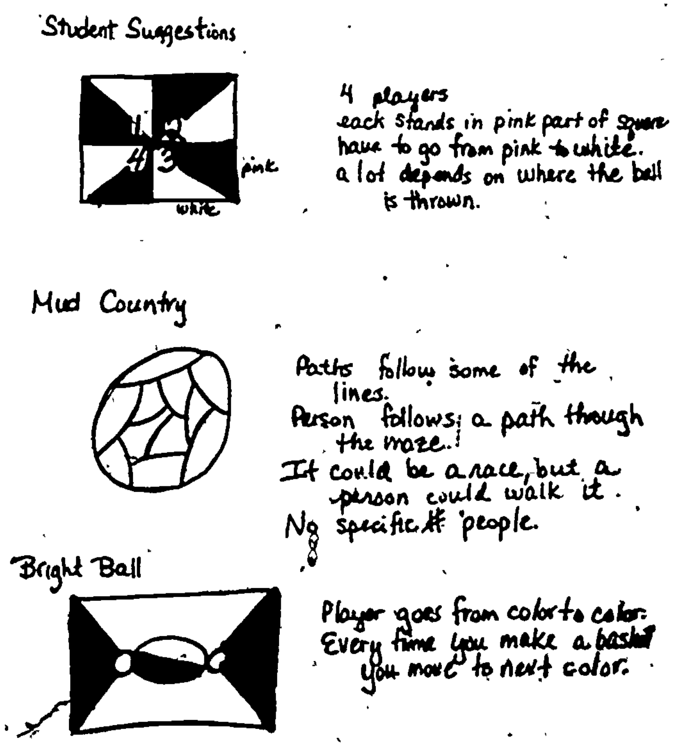


Figure C4-1

dents ideas about using color and line in redesigning the games. "We can paint more than one game and use bright colors," I suggested.

"We can paint a peace sign," added one student.

I responded, "You can do that. If we painted circle dodge, for example, in a different way, could we invent a new game to play? What if we painted the circles different colors?"

"Then," replied one child, "have one person in the center and everyone else around the edge."

"Is there another game?" I asked.

"Dodge the arrow," noted one student.

"Could we play dodge ball in reverse?" I questioned. "What if you had one student in the center and he tried to hit moving people around the edges?"

"Yes!" exclaimed another child. "If we painted the blacktop with bright colors, we could play out there and have more fun."

The group that was sketching the designs of our blacktop games subsequently returned and made a presentation of their findings to their classmates. I asked each child in the class to choose one of the game designs to repaint in bright colors and to think of three different ways to play the repainted game. I asked them also to include with their new design ideas descriptions of how to play their games.

Some of my students chose the circle games and tried to draw free hand circles. One of them wanted his drawing to look "more like a circle." He looked around the room, found a pail, and traced its circumference. Another student wanted to draw a volleyball court--something we did not have on our playground. He went outside to see whether or not it would fit on the blacktop area.

Three to five variations of each game design were conceived by most students. Some of their ideas are illustrated in Figure C4-1 while others are described below:

1. Four-square with letters instead of numbers painted with "double colors"
2. Dodgeball with a court drawn like a bull's-eye
3. Basketball court with stripes
4. Hopscotch court using colors or letters rather than numbers

One child focused the attention of the class on the following two problems that she saw in their plans for the blacktop:

1. Where would we get the paint?
2. How could we keep children off the area while the paint dried?

Two committees were formed to deal with these problems. The activities of the committees are described below.

The Scroungers:

Several children volunteered to scrounge for paint in the neighborhood. I asked them what they should do and say when soliciting the supplies. We listed their responses, which can be seen below, on the board.

TO DO	TO SAY
1. Be polite	1. Where are we from and who we are
2. Speak up	2. What we want
3. Speak correctly	3. What we want to use it for
4. Dress nicely	
5. Be polite if refused	
6. Take turns talking	

Other children decided to pass out information about our activities to the rest of the school. They decided to include our room number, our plans, the benefits, and the needed supplies in the informational letters.

The entire class was extremely enthusiastic about scrounging the necessary materials. They did very well, too! We acquired twelve to fifteen gallons of asphalt paint and numerous brushes and rollers. It was very exciting.

Sawhorse Builders:

While the scroungers canvassed the neighborhoods, four boys worked in the Design Lab on the construction of some sawhorses to keep people off the designs while they were still wet. They developed plans and then measured and cut the desired lengths of wood. Two beautiful sawhorses were subsequently put together. Unfortunately, the boys did not reinforce the sawhorses and soon discovered that when children sat on them, the legs spread apart and finally broke. The sawhorses were taken back to the Design Lab and reinforced. After that, they worked beautifully and seemed to be unbreakable. (See sketch on next page.)

First Design Finished Design

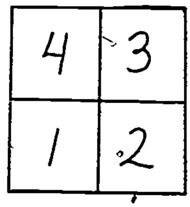
After provision had been made for paint and for protection of our designs, we divided into groups to work on some of the design ideas. I have included a description of the activities of two groups of students.

The 4-Square Group:

Four children wanted to work on redesigning the 4-Square. They planned to repaint the game as described below:

1--red
2--green
3--white
4--yellow

numbers, lines → blue



They described the following games as ones that could be played using their design:

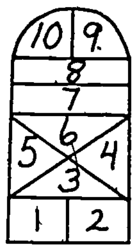
1. Regular 4-Square.
2. Case around colors: each team member on two teams is assigned a color. Captain calls a color--team members assigned this color must race each other to the designated square. The winner becomes captain.
3. Repeating 4-Square with a Ball: a child in #4 throws ball up four times, passes it to #3 who throws ball up three times, #2--two times, #1--one time. Then #4 starts a new activity (e.g., bouncing the ball). When someone misses, another child takes his or her place.
4. Arithmetic 4-square: captains and teams. Captain calls, for example, "two plus two." The runners must add, subtract, or whatever other process is called, and run to square with correct answer--first runner there becomes the Captain.

The four students went outside to measure and lay out their area. One child suggested using masking tape to draw straight lines. Since the other members of the group agreed, they marked off the lines and began to paint the outside lines. One girl noticed that they were beginning to box themselves inside, and so they changed their painting method and began to paint the inside corners of the box. Then they discussed how the numbers might be made so that the numerals would be straight. One child again suggested taping them and painting between the tape so that the numbers would be even. They tried it and were pleased with the results.

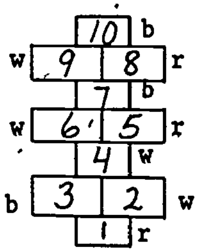
The girls were very happy about the results of their painting, and they received many compliments on their efforts. Everyone was very excited about the new games and the colorful design.

Hopscotch Group:

Three children had chosen to redesign the hopscotch game which originally looked like this:



The new game they had devised was made up of squares and looked like this:



b--blue
r--red
w--white

They had thought of four games:

1. Regular hopscotch.
2. Colors hopscotch: regular hopscotch but rather than stones, a child picks a color and runs the the course using only the color he or she chooses, for example, a child chooses red, and so he or she runs the course but can only step on red.
3. Evens and odds hopscotch: child chooses either an even number or an odd number and can run the

course stepping only on either even or odd squares.

4. One-color hopscotch: child chooses one color on which he or she can never step. He or she can run the course on everything but the "poison" color--if he or she steps on it, it's back to the starting line!

We discussed whether we could put the new hopscotch game within the framework of the old. Two children noticed that the existing block for #1 and #2 could be used for the new #2 and #3 blocks. They decided to tape around the #1 and #2, add on a new #1 block below, and then add on the #4 to #10 block above.

One of the girls observed that the squares were larger than before and wondered whether hopscotch could still be played. All three girls tried playing on the outlined figure and were successful. They decided to ask one of the first or second graders to try out the game. They thought that maybe the little ones would have difficulty playing the game. They found a small child who hopped around the outlined figure and declared it a good size.

A great deal of enthusiasm and energy was sparked by the blacktop project. The weather, however, did not cooperate--it often rained or snowed. The blacktop was often too wet to paint, and several games had to be repainted on sunny days. When work was completed, all of the children agreed that the project was worth their efforts. The freshly designed and painted area was used by all of the children in the school.

D. References

1. LIST OF "HOW TO" CARDS

Below are listed the current "How To" Card titles that students working on the Play Area Design and Use challenge might find useful. A complete listing of both the "How To" Cards and the Design Lab "How To" Cards is contained in the USMES Guide. In addition, the Design Lab Manual contains the list of Design Lab "How To" Cards.

GEOMETRY

G 3 How to Construct a Circle Which is a Certain Distance Around

GRAPHING

GR 1 How to Make a Bar Graph Picture of Your Data
GR 2 How to Show the Differences in Many Measurements or Counts of the Same Thing by Making a Histogram
GR 3 How to Make a Line Graph Picture of Your Data
GR 4 How to Decide Whether to Make a Bar Graph Picture or a Line Graph Picture of Your Data
GR 5 How to Find Out If There is Any Relationship Between Two Things by Making a Scatter Graph
GR 6 How to Make Predictions by Using a Scatter Graph
GR 7 How to Show Several Sets of Data on One Graph

MEASUREMENT

M 1 How to Use a Stopwatch
M 2 How to Measure Distances
M 3 How to Measure Large Distances by Using a Trundle Wheel
M 4 How to Find the Height of a Building or Tree
M 5 How to Measure the Height of a Building or Tree When You Can't Use a 45 Degree Sighting Angle
M 8 How to Measure a Sighting Angle to the Top of a Building or Tree
M 9 How to Make a Conversion Graph to Use in Changing Measurements from One Unit to Another Unit
M 10 How to Use a Conversion Graph to Change *Any* Measurement in One Unit to Another Unit

PROBABILITY AND STATISTICS

PS 2 How to Record Data by Tallying
PS 3 How to Describe Your Set of Data by Finding the Average
PS 4 How to Describe Your Set of Data by Using the Middle Piece (Median)
PS 5 How to Find the Median of a Set of Data from a Histogram

RATIOS, PROPORTIONS, AND SCALING

R 1 How to Compare Fractions or Ratios by Making a Triangle Diagram*
R 2 How to Make a Drawing to Scale
R 3 How to Make Scale Drawings Bigger or Smaller

New titles to be added in 1976:

How to Round Off Data
How to Make and Use a Cumulative Distribution Graph

A cartoon-style set of "How To" Cards for primary grades is being developed from the present complete set. In most cases titles are different and contents have been rearranged among the various titles. It is planned that this additional set will be available early in 1977.

143

*Presently called slope diagram.

2. LIST OF BACKGROUND PAPERS

As students work on USMES challenges, teachers may need background information that is not readily accessible elsewhere. The Background Papers fulfill this need and often include descriptions of activities and investigations that students might carry out.

Below are listed titles of current Background Papers that teachers may find pertinent to Play Area Design and Use. The papers are grouped in the categories shown, but in some cases the categories overlap. For example, some papers about graphing also deal with probability and statistics.

The Background Papers are being revised, reorganized, and rewritten. As a result, many of the titles will change.

DESIGN PROBLEMS

- DP 6 *What Can You Do with Tires and Ropes?* by Playground Design and Use Group--1972 Boston Summer Workshop
- DP13 *People and Space* by Gorman Gilbert

GROUP DYNAMICS

- GD 2 *A Voting Procedure Comparison That Might Arise in USMES Activities* by Earle Lomon

GRAPHING

- GR 2 *Notes on Data Handling* by Percy Pierre
- GR 3 *Using Graphs to Understand Data* by Earle Lomon
- GR 4 *Representing Several Sets of Data on One Graph* by Betty Beck
- GR 6 *Using Scatter Graphs to Spot Trends* by Earle Lomon
- GR 7 *Data Gathering and Generating Graphs at the Same Time (or Stack 'Em and Graph 'Em at One Fell Swoop!)* by Edward Liddle

MEASUREMENT

- M 2 *Measuring Heights of Trees and Buildings* by Earle Lomon
- M 3 *Determining the Best Instrument to Use for a Certain Measurement* by USMES Staff
- M 5 *Electric Trundle Wheel* by Charles Donahoe

PROBABILITY AND STATISTICS

- PS 1 *Collecting Data in Sets or Samples* by USMES Staff
- PS 4 *Design of Surveys and Samples* by Susan J. Devlin and Anne E. Freeny

3. BIBLIOGRAPHY OF NON-USMES MATERIALS

The following books are references that may be of some use during work on Play Area Design and Use. A list of references on general mathematics and science topics can be found in the USMES Guide.

Books for Teachers

African Primary Science Program, *Playground Equipment*. Newton, Massachusetts: Education Development Center, Inc.

The four sections of this book (swings, levers and balances, sliding and climbing, calendars and clocks) offer diagrams and instructions for the construction of many designs. Each section contains pages in areas of learning as they apply to the section.

Ellison Gail, *Play Structures*. Pasadena, California: Pacific Oaks College and Children's School, 1974.

A book for everyone interested in building creative play structures--adults and children. The purpose of this guide, as stated by the author, is to generate discussion and suggest possibilities. Included in this book are pictures, designs and an interesting text that can be read by adults and older children.

Farallones Designs, *Farallones Scrapbook*. Berkley: The Boys in the Back, 1971. (Order from Farallones Designs, Star Route, Point Reyes Station, California 94956.)

An excellent resource book for teachers. Two chapters in particular are applicable to the unit: "Geometry and Dome Building," "Playground Building."

Hogan, Paul, *Playgrounds for Free*. Cambridge, Massachusetts: MIT Press, 1974.

An extremely useful resource for teachers whose classes want to create or improve a play area with limited or no available funds.

Sharkley, Tony, *Building a Playground*. Newton, Massachusetts: Education Development Center, Inc., 1970.

This book documents the planning and construction of a play area by members of a playground workshop at Texas Southern University.

Southern Day Care Project, *Planning Playgrounds for Day Care.* Atlanta, Georgia: Southeastern Regional Educational Board, 1973. (Order from ERIC Document Reproduction Service, P.O. Drawer O, Bethesda, Maryland 20014, ERIC number ED 083-719, $3.29 hardcover.)

Originally prepared to aid day care centers in making the most effective use of outdoor play space, this booklet provides valuable information and ideas on equipment, surfaces, planning--adult vs. children, community involvement--and design.

4. GLOSSARY

The following definitions may be helpful to a teacher whose class is investigating a Play Area Design and Use challenge. Some of the words are included to give the teacher an understanding of technical terms; others are included because they are commonly used throughout the resource book. These terms may be used when they are appropriate for the children's work. For example, a teacher may tell the children that when they conduct opinion surveys, they are collecting *data*. It is not necessary for the teacher or students to learn the definitions nor to use all of these terms while working on their challenge. Rather, the children will begin to use the words and understand the meanings as they become involved in their investigations.

Average — The numerical value obtained by dividing the sum of the elements of a set of data by the number of elements in that set. Also called the mean.

Bias — A deviation in the expected values of a set of data, often occurring when some factor produces one outcome more frequently than others.

Comparative Shopping — A method for determining the best buy(s) by comparing the costs, quantities, and qualities of different brands of products.

Concentric — Having a common center.

Congestion — A traffic flow problem that exists when the volume or density of traffic affects average speed to the point where normal traffic flow is reduced sharply.

Conversion — A change from one form to another. Generally associated in mathematics and science with the change from one unit of measure to another or the change from one form of energy to another.

Correlation — A relationship between two sets of data.

Cost — The amount of money needed to produce or to purchase goods or services.

Data — Any facts, quantitative information, or statistics.

Discount — A reduction in the price of products or services, often stated as a percentage of price. This is done (1) for customers who buy in large quantities or (2) in order to generate a greater volume of sales.

Distribution — The spread of data over the range of possible results.

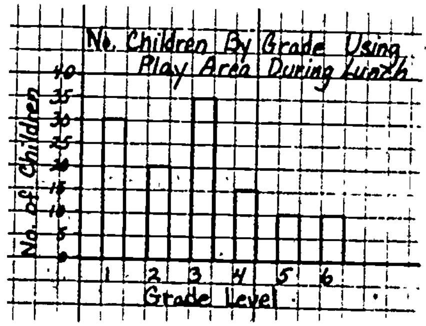
Economics — A social science concerned chiefly with description and analysis of the production, distribution, and consumption of goods and services.

Event — A happening; an occurrence; something that takes place. Example: one child using the swings for ten minutes during recess.

Frequency — The number of times a certain event occurs in a given unit of time or in a given total number of events.

Graph — A drawing or a picture of one or several sets of data.

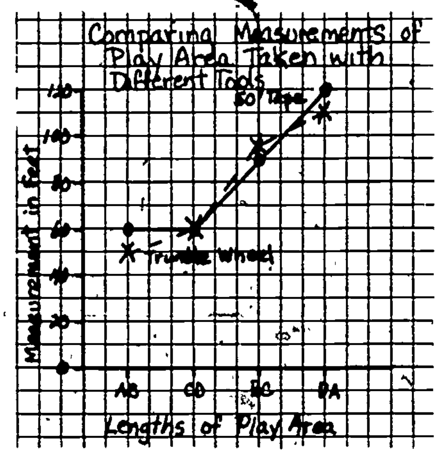
Bar Graph — A graph of a set of measures or counts whose sizes are represented by the vertical (or horizontal) lengths of bars of equal widths. Example: the number of children by grade level who use the play area during lunch.



Data Table

No. of Children	Grade Level
30	1
20	2
35	3
15	4
10	5
10	6

A bar graph that is represented by circles, triangles, or crosses with lines connecting them so that it has the appearance of a line graph is called a *line chart*. (See *Line Graph*.) This is a useful representation when two or more sets of data are shown on the same graph. Example: measurements of play area using different tools.

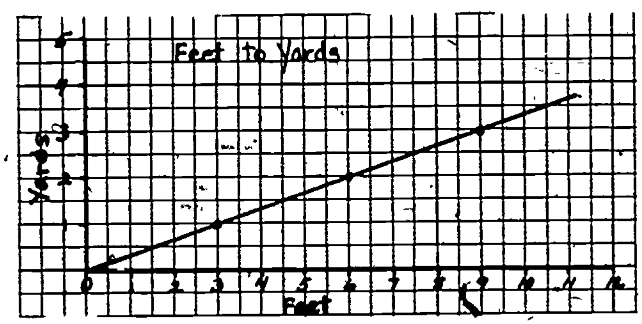


Data Table

Lengths of Play Area	Measurements in Ft 50' tape	trundle wheel
AB	60	50
CD	60	60
BC	90	95
DA	120	110

Conversion Graph

A line graph that is used to change one unit of measurement to another. For example, changing feet to yards, or vice versa.

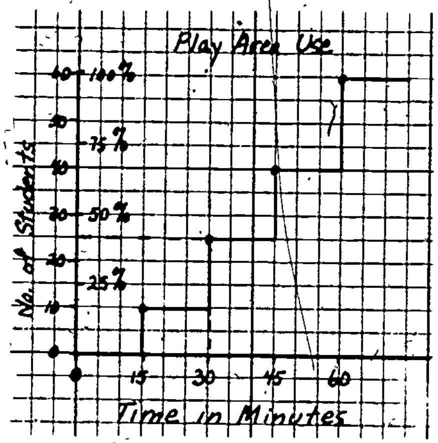


Data Table

Feet	Yards
3	1
6	2
9	3

Cumulative Distribution Graph

A graph that can be constructed from a histogram by computing running totals from the histogram data. The first running total is the first value in the histogram data (see table of values.) The second running total is the sum of the first and second values of the histogram, the third is the sum of the first, second, and third values, and so on. The horizontal scale on the graph is similar to that of the histogram; the vertical scale goes from 0 to the total number of events observed or samples taken (for example, the total number of students who used the play area for certain lengths of time). Each vertical distance on the graph shows the running total of the number of samples taken that are less than or equal to the value shown on the horizontal scale; thus the graph below indicates that 25 students, or 42% of the total, used the play area for 30 minutes or less.

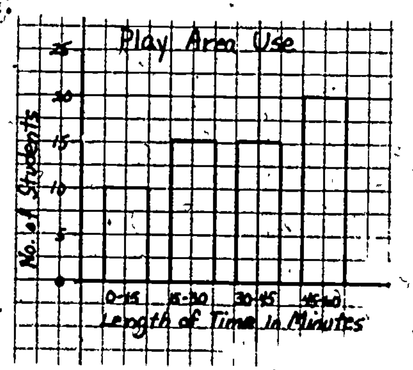


Data Table

Length of Time in Minutes	No. of Children	Running Totals
15 or less	10	10
30 " "	15	25
45 " "	15	40
60 " "	20	60

Histogram

A type of bar graph that shows the distribution of the number of times that different measures or counts of the same event have occurred A histogram always shows ordered numerical data on the horizontal axis. Example: the different number of children who use the play area for certain lengths of time.



Data Table

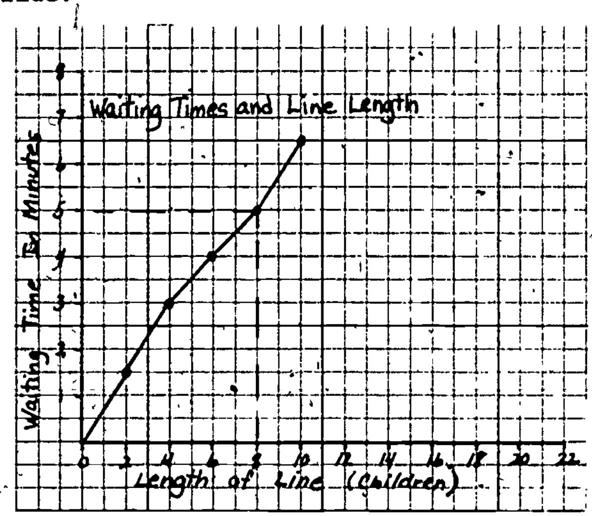
Lengths of Time in Minutes	No. of Children
15	10
30	15
45	15
60	20

Line Chart

See *Bar Graph*.

Line Graph

A graph in which a smooth line or line segments pass through or near points representing members of a set of data. Since the line represents an infinity of points, the variable on the horizontal axis must be continuous. If the spaces between the markings on the horizontal axis have no meaning, then the graph is not a line graph, but a line chart (see *Bar Graph*), even if the data points are connected by lines. Example: the time spent waiting in line for a slide vs. the length of the line. The graph below indicates that a child in a line eight children long waited five minutes for the slide.

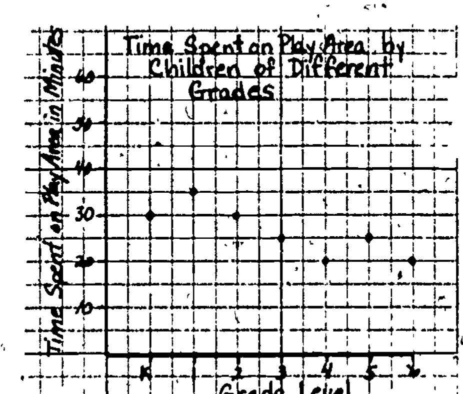


Data Table

Length of Line	Waiting Time in Minutes
2	1½
4	3
6	4
8	5
10	6½

Scatter Graph

A graph showing a scatter of points, each of which represents two characteristics of the same thing. For example, in the graph below, each point represents the grade level of a class and the amount of time the class spends on the play area.

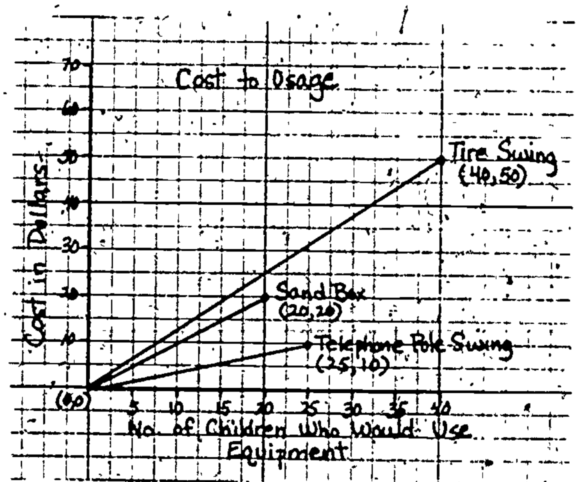


Data Table

Grade Level	Time Spent on Play Area in Minutes
K	30
1	35
2	30
3	25
4	20
5	25
6	20

*Slope Diagram**

A graphical means of comparing fractions or ratios. To represent the ratio a/b, plot the point (b,a) and draw a line from (b,a) to the origin, (0,0). The slope of this line represents the ratio a/b. By comparing slopes of several lines, different ratios can be compared; the steeper the line, the larger the ratio, the less steep the line the smaller the ratio. For example, the diagram shows the ratio of price to possible usage during recess for different types of equipment. The ratio of price to possible usage for the telephone pole swing is smaller than that for the sand box and tire swing, and therefore, the telephone pole swing would be the most economical in terms of price and usage.



Data Table

Type of Equip.	Possible Usage (No. of Children)	Price in Dollars
telephone pole swing	25	10
sand box	20	20
tire swing	40	50

Histogram

See *Graph*.

Hypothesis

A tentative conclusion made in order to test its implications or consequences.

Inference

An assumption derived from facts or information considered to be valid and accurate.

Matrix

A chart of data arranged in rows and columns.

Mean

See *Average*.

Median

The middle value of a set of data in which the elements have been ordered from smallest to largest. The median value has as many elements above it as below it.

*Formerly referred to as triangle diagram.

Mode — The element or elements in a set of data that occur most often.

Ordered Set — A set of data arranged from smallest to largest.

Per Cent — Literally per hundred. A ratio in which the denominator is always 100, e.g., 72 per cent = 72/100 = 0.72 = 72%, where the symbol % represents 1/100.

Percentage — A part of a whole expressed in hundredths.

Population — Any group of objects (e.g., people, animals, items) or events from which samples are taken for statistical measurement.

Probability — The likelihood or chance (expressed numerically) of one event occurring out of several possible events.

Proportion — A statement of equality of two ratios, i.e., the first term divided by the second term equals the third term divided by the fourth term, e.g., 5/10 = 1/2. Also a synonym for ratio: when two quantities are in direct proportion, their ratios are the same.

Range — Mathematical: the difference between the smallest and the largest values in a set of data.

Rank — To order the members of a set according to some criterion, such as size or importance. Example: to put pieces of data from smallest to largest.

Ratio — The quotient of two denominate numbers or values indicating the relationship in quantity, size, or amount between two different things. For example, the ratio of the number of children who can use a piece of equipment to the area occupied by the equipment might be

$$\frac{\text{10 children}}{4\frac{1}{2}\text{ square meters}}$$ or 10 children:4½ square meters.

Recycle — To process a discarded item for reuse, either for its original purpose or for a new purpose.

Retail Price — The price level of goods sold in small quantity to the consumer.

Sample — A representative fraction of a population studied to gain information about the whole population.

Sample Size	A number of elements in a sample.
Scale	A direct proportion between two sets of dimensions (as between the dimensions in a drawing of a play area and the actual play area).
Scale Drawing	A drawing whose dimensions are in direct proportion to the object drawn.
Scale Map	A map whose dimensions are in direct proportion to the dimensions of the area represented.
Scale Model	A three-dimensional representation constructed to scale.
Set	A collection of characteristics, persons, or objects. Each thing in a set is called a member or an element.
*Slope Diagram**	See *Graph*.
Statistics	The science of drawing conclusions or making predictions using a collection of quantitative data.
Tally	A visible record used to keep a count of some set of data, especially a record of the number of times one or more events occur. Example: the number of children who use each piece of play equipment during a certain amount of time.

*Formerly referred to as triangle diagram.

E. Skills, Processes, and Areas of Study Utilized in Play Area Design and Use

The unique aspect of USMES is the degree to which it provides experience in the process of solving real problems. Many would agree that this aspect of learning is so important as to deserve a regular place in the school program even if it means decreasing to some extent the time spent in other important areas. Fortunately, real problem solving is also an effective way of learning many of the skills, processes, and concepts in a wide range of school subjects.

On the following pages are five charts and an extensive, illustrative list of skills, processes, and areas of study that are utilized in USMES. The charts rate Play Area Design and Use according to its potential for learning in various categories of each of five subject areas--real problem solving, mathematics, science, social science, and language arts. The rating system is based on the amount that each skill, process, or area of study within the subject areas is used--extensive (1), moderate (2), some (3), little or no use (-). (The USMES Guide contains a chart that rates all USMES units in a similar way.)

The chart for real problem solving presents the many aspects of the problem-solving process that students generally use while working on an USMES challenge. A number of the steps in the process are used many times and in different orders, and many of the steps can be performed concurrently by separate groups of students. Each aspect listed in the chart applies not only to the major problem stated in the unit challenge but also to many of the tasks each small group undertakes while working on a solution to the major problem. Consequently, USMES students gain extensive experience with the problem-solving process.

The charts for mathematics, science, social science, and language arts identify the specific skills, processes, and areas of study that may be learned by students as they respond to a Play Area Design and Use challenge and become involved with certain activities. Because the students initiate the activities, it is impossible to state unequivocally which activities will take place. It is possible, however, to document activities that have taken place in USMES classes and identify those skills and processes that have been used by the students.

Knowing in advance which skills and processes are likely to be utilized in Play Area Design and Use and knowing the extent that they will be used, teachers can postpone the teaching of those skills in the traditional manner until later in the year. If the students have not learned them during their USMES activities by that time, they can study them in the usual way. Further, the charts enable a teacher to integrate USMES more readily with other areas of classroom work. For example, teachers may teach fractions during math period when fractions are also being learned and utilized in the students' USMES activities. Teachers who have used USMES for several successive years have found that students are more motivated to learn basic skills when they have determined a need for them in their USMES activities. During an USMES session the teacher may allow the students to learn the skills entirely on their own or from other students, or the teacher may conduct a skill session as the need for a particular skill arises.

Because different USMES units have differing emphases on the various aspects of problem solving and varying amounts of possible work in the various subject areas, teachers each year might select several possible challenges, based on their students' previous work in USMES, for their class to consider. This choice should provide students with as extensive a range of problems and as wide a variety of skills, processes, and areas of study as possible during their years in school. The charts and lists on the following pages can also help teachers with this type of planning.

Some USMES teachers have used a chart similar to the one given here for real problem solving as a record-keeping tool, noting each child's exposure to the various aspects of the process. Such a chart might be kept current by succeeding teachers and passed on as part of a student's permanent record. Each year some attempt could be made to vary a student's learning not only by introducing different types of challenges but also by altering the specific activities in which each student takes part. For example, children who have done mostly construction work in one unit may be encouraged to take part in the data collection and data analysis in their next unit.

Following the rating charts are the lists of explicit examples of real problem solving and other subject area skills, processes, and areas of study learned and utilized in Play Area Design and Use. Like the charts, these lists are based on documentation of activities that have taken place in USMES classes. The greater detail of the lists allows teachers to see exactly how the various basic skills, processes, and areas of study listed in the charts may arise in Play Area Design and Use.

The number of examples in the real problem solving list have been limited because the list itself would be unreasonably long if all the examples were listed for some of the categories. It should also be noted that the example(s) in the first category--*Identifying and Defining Problems*--have been limited to the major problem that is the focus of the unit. During the course of their work, the students will encounter and solve many other, secondary problems, such as the problem of how to display their data or how to draw a scale layout.

Breaking down an interdisciplinary curriculum like USMES into its various subject area components is a difficult and highly inexact procedure. Within USMES the various subject areas overlap significantly, and any subdivision must be to some extent arbitrary. For example, where does measuring as a mathematical skill end and measurement as science and social science process begin? How does one distinguish between the processes of real problem solving, of science, and of social science? Even within one subject area, the problem still remains--what is the difference between graphing as a skill and graphing as an area of study? This problem has been partially solved by judicious choice of examples and extensive cross-referencing.

Because of this overlap of subject areas, there are clearly other outlines that are equally valid. The scheme presented here was developed with much care and thought by members of the USMES staff with help from others knowledgeable in the fields of mathematics, science, social science, and language arts. It represents one method of examining comprehensively the scope of USMES and in no way denies the existence of other methods.

REAL PROBLEM SOLVING	Overall Rating
Identifying and defining problem.	1
Deciding on information and investigations needed.	1
Determining what needs to be done first, setting priorities.	2
Deciding on best ways to obtain information needed.	1
Working cooperatively in groups on tasks.	1
Making decisions as needed.	1
Utilizing and appreciating basic skills and processes.	1
Carrying out data collection procedures--opinion surveying, researching, measuring, classifying, experimenting, constructing.	1
Asking questions, inferring.	1
Distinguishing fact from opinion, relevant from irrelevant data, reliable from unreliable sources.	1
Evaluating procedures used for data collection and analysis. Detecting flaws in process or errors in data.	1

REAL PROBLEM SOLVING	Overall Rating
Organizing and processing data or information.	1
Analyzing and interpreting data or information.	1
Predicting, formulating hypotheses, suggesting possible solutions based on data collected.	1
Evaluating proposed solutions in terms of practicality, social values, efficacy, aesthetic values.	1
Trying out various solutions and evaluating the results, testing hypotheses.	1
Communicating and displaying data or information.	1
Working to implement solution(s) chosen by the class.	1
Making generalizations that might hold true under similar circumstances; applying problem-solving process to other real problems.	1

KEY: 1 = extensive use, 2 = moderate use, 3 = some use, - = little or no use

MATHEMATICS	Overall Rating
Basic Skills	
Classifying/Categorizing	3
Counting	1
Computation Using Operations	
Addition/Subtraction	1
Multiplication/Division	1
Fractions/Ratios/Percentages	1
Business and Consumer Mathematics/ Money and Finance	2
Measuring	1
Comparing	2
Estimating/Approximating/Rounding Off	1
Organizing Data	1
Statistical Analysis	1
Opinion Surveys/Sampling Techniques	2
Graphing	1
Spatial Visualization/Geometry	1
Areas of Study	
Numeration Systems	1
Number Systems and Properties	1
Denominate Numbers/Dimensions	1
Scaling	2
Symmetry/Similarity/Congruence	3
Accuracy/Measurement Error/Estimation/ Approximation	1
Statistics/Random Processes/Probability	1
Graphing/Functions	1
Fraction/Ratio	1
Maximum and Minimum Values	3
Equivalence/Inequality/Equations	2
Money/Finance	2
Set Theory	3

SCIENCE	Overall Rating
Process	
Observing/Describing	1
Classifying	2
Identifying Variables	2
Defining Variables Operationally	2
Manipulating, Controlling Variables/ Experimenting	2
Designing and Constructing Measuring Devices and Equipment	1
Inferring/Predicting/Formulating, Testing Hypotheses/Modeling	1
Measuring/Collecting, Recording Data	1
Organizing, Processing Data	1
Analyzing, Interpreting Data	1
Communicating, Displaying Data	1
Generalizing/Applying Process to New Problems	1
Areas of Study	
Measurement	1
Motion	3
Force	3
Mechanical Work and Energy	3
Solids, Liquids, and Gases	3
Electricity	-
Heat	-
Light	-
Sound	-
Animal and Plant Classification	-
Ecology/Environment	3
Nutrition/Growth	-
Genetics/Heredity/Propagation	-
Animal and Plant Behavior	-
Anatomy/Physiology	3

KEY: 1 = extensive use, 2 = moderate use, 3 = some use, - = little or no use

SOCIAL SCIENCE

	Overall Rating
Process	
Observing/Describing/Classifying	2
Identifying Problems, Variables	1
Manipulating, Controlling Variables/ Experimenting	2
Inferring/Predicting/Formulating, Testing Hypotheses	1
Collecting, Recording Data/Measuring	2
Organizing, Processing Data	2
Analyzing, Interpreting Data	2
Communicating, Displaying Data	2
Generalizing/Applying Process to Daily Life	1
Attitudes/Values	
Accepting responsibility for actions and results	1
Developing interest and involvement in human affairs	1
Recognizing the importance of individual and group contributions to society	1
Developing inquisitiveness, self-reliance, and initiative	1
Recognizing the values of cooperation, group work, and division of labor	1
Understanding modes of inquiry used in the sciences, appreciating their power and precision	1
Respecting the views, thoughts, and feelings of others	1
Being open to new ideas and information	1
Learning the importance and influence of values in decision making	1
Areas of Study	
Anthropology	–
Economics	1
Geography/Physical Environment	3
Political Science/Government Systems	1
Recent Local History	3
Social Psychology/Individual and Group Behavior	3
Sociology/Social Systems	2

LANGUAGE ARTS

	Overall Rating
Basic Skills	
Reading	
Literal Comprehension: Decoding Words, Sentences, Paragraphs	1
Critical Reading: Comprehending Meanings, Interpretation	2
Oral Language	
Speaking	1
Listening	1
Memorizing	3
Written Language	
Spelling	1
Grammar: Punctuation, Syntax, Usage	1
Composition	1
Study Skills	
Outlining/Organizing	1
Using References and Resources	1
Attitudes/Values	
Appreciating the value of expressing ideas through speaking and writing	1
Appreciating the value of written resources.	1
Developing an interest in reading and writing	2
Making judgments concerning what is read	2
Appreciating the value of different forms of writing, different forms of communication	1

KEY: 1 = extensive use, 2 = moderate use
3 = some use, – = little or no use

REAL PROBLEM SOLVING IN PLAY AREA DESIGN AND USE

Identifying and Defining Problems

- Students decide that overcrowding is a problem on their play area.
- See also SOCIAL SCIENCE list: *Identifying Problems, Variables.*

Deciding on Information and Investigations Needed

- After a preliminary discussion students decide to observe the play area at different times during the day.
- After discussing the results of their observations students decide more data on play area use at different times of the day are needed.
- Students agree to collect data on scheduled use of the space by different grade levels during recess periods and lunches.
- Students agree to conduct opinion survey on use of the play area.
- Students decide to map the play area indicating the location of various pieces of equipment.

Determining What Needs to Be Done First, Setting Priorities

- Children decide to observe play area first, then to collect data before trying to develop a solution.
- Students decide to research present scheduling before suggesting new one.
- Students borrow and learn to use a stopwatch before measuring use and waiting times at various pieces of equipment.

Deciding on Best Ways to Obtain Information Needed

- Children establish a schedule for different students to observe the use of play area at different times of day, e.g., primary recess, intermediate recess, lunch time, physical education class time.
- Children decide that one child will operate the stopwatch and another will record the times when measuring the waiting and use times at various pieces of equipment.
- Students decide that two children will measure the same section of the play area to insure accuracy of measurements.
- Children decide to survey five children in each class to determine whether others consider overcrowding a problem and to pinpoint specific trouble spots.

Deciding on Best Ways to Obtain Information Needed (cont.)	• Children decide to ask the principal about the reasons for scheduling use of the area as it is now and request permission to proceed with their work.
Working Cooperatively in Groups on Tasks	• Students form groups to collect data on the use of various pieces of equipment at different times of the day and on the scheduled use of the space by classes during the day, to survey other classes about play area use and activity preference, and to make a scale drawing of the play area.
Making Decisions as Needed	• Students decide to work in groups so that more can be accomplished. • Students decide to propose a new schedule for use of the area, a new arrangement of space, and the purchase of additional equipment as a solution. • Students decide to make a presentation to the principal to get approval for their plans to change the use of the play area.
Utilizing and Appreciating Basic Skills and Processes	• Students measure the dimensions of the play area and equipment to draw a scale layout. • Students divide to decrease measurements for scale layout. • Students draw graphs of use of various pieces of equipment during certain time periods. • Students recognize that improving the use of the play area will reduce overcrowding and will help many people besides themselves, namely, other children in the school. • Students give oral presentations to principal. • See also MATHEMATICS, SCIENCE, SOCIAL SCIENCE, and LANGUAGE ARTS lists.
Carrying Out Data Collection Procedures--Opinion Surveying, Researching, Measuring, Classifying, Experimenting, Constructing	• Students conduct opinion survey to determine whether others consider overcrowding to be a problem--which locations, times--and/or to determine activity preferences of schoolmates. • Students measure dimensions of play area. • Students tally the use of various pieces of equipment by different grades. • Students research available funds and costs of various types of equipment. • See also MATHEMATICS list: *Classifying/Categorizing; Measuring.*

Carrying Out Data Collection Procedures--Opinion Surveying, Researching, Measuring, Classifying, Experimenting, Constructing (cont.)	• See also SCIENCE list: *Observing/Describing; Classifying; Manipulating, Controlling Variables/Experimenting; Designing and Constructing Measuring Devices and Equipment; Measuring/Collecting, Recording Data.* • See also SOCIAL SCIENCE list: *Observing/Describing; Classifying; Manipulating, Controlling Variables/ Experimenting; Collecting, Recording Data/Measuring.*
Asking Questions, Inferring	• Students ask whether play area is overcrowded and infer from data collected that it is. • Students ask whether rearranging scheduled use of the play area, purchasing additional equipment, and relocating play spaces on the area will make it less crowded and more fun. They infer that fewer children on the space at a given time and a mixed age group as well as additional equipment will reduce waiting lines at pieces of equipment. • See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses/Modeling.* • See also SOCIAL SCIENCE list: *Inferring/Predicting/ Formulating, Testing Hypotheses.*
Distinguishing Fact from Opinion, Relevant from Irrelevant Data, Reliable from Unreliable Sources	• Students recognize the qualitative aspects of obtaining data from opinion surveys as distinct from data they gather at a particular piece of play area equipment. • Students recognize that use during lunch is not necessarily a good indication of use during recess. • Students realize that equipment catalogs are reliable sources of information on playground equipment.
Evaluating Procedures Used for Data Collection and Analysis, Detecting Flaws in Process or Errors in Data	• Students discover that body measurements were taken in different ways, for example, weight, knee-to-floor height. They then refine and standardize their procedures. • Children decide that their equipment preference survey does not give the information they want. They discuss changes they need to make in it. • Students measuring a play area with a variety of measuring devices obtain widely varying results. They discuss the discrepancies and choose one instrument for making final measurements. • See also MATHEMATICS list: *Estimating/Approximating/ Rounding Off.*

Organizing and Processing Data	• Students order and group data on play area use to plot graphs. • See also MATHEMATICS list: *Organizing Data.* • See also SCIENCE and SOCIAL SCIENCE lists: *Organizing, Processing Data.*
Analyzing and Interpreting Data	• Children determine how much each piece of equipment is used. • Students select new equipment and/or games according to usage data and student preferences. • See also MATHEMATICS list: *Comparing; Statistical Analysis; Opinion Surveys/Sampling Techniques; Graphing; Maximum and Minimum Values.* • See also SCIENCE and SOCIAL SCIENCE lists: *Analyzing, Interpreting Data.*
Predicting, Formulating Hypotheses, Suggesting Possible Solutions Based on Data Collected	• After measuring play area use and polling students for activity preferences, children hypothesize that a new organization of the play space will reduce the number of accidents. • After investigating, children suggest that the students' use of the play area be rescheduled and that additional equipment be purchased to reduce overcrowding. • See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses/Modeling.* • See also SOCIAL SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*
Evaluating Proposed Solutions in Terms of Practicality, Social Values, Efficacy, Aesthetic Values	• Students discuss advantages and disadvantages of proposed changes--scheduling of use, rearrangement of play area, additional equipment. • Children discuss whether proposed changes will be fair.
Trying Out Various Solutions and Evaluating the Results, Testing Hypotheses	• Students use a scale layout of the play area to find the best arrangement of the play area and new equipment. • After implementing a new schedule on and arrangement of the play area, the class collects further data to determine the effect of their changes. • Students discuss how they feel about the new look and use of their play area and whether they enjoy it more than before work on the challange was initiated. • See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses/Modeling.*

Trying Out Various Solutions and Evaluating the Results, Testing Hypotheses (cont.)	• See also SOCIAL SCIENCE list: *Inferring/Predicting/ Formulating, Testing Hypotheses.*
Communicating and Displaying Data or Information	• Students draw a histogram to show student measurements. • Children prepare bar graphs and line charts to show and compare the use of different pieces of play equipment by children of various ages. • Students draw scale layout of play area. • Students inform their schoolmates of the changes. • See also MATHEMATICS list: *Graphing; Scaling.* • See also SCIENCE and SOCIAL SCIENCE lists: *Communicating, Displaying Data.* • See also LANGUAGE ARTS list.
Working to Implement Solution(s) Chosen by the Class	• Children make presentation of their proposed changes and additions to the play area to the principal and/or PTA. • Students reorganize the play area and its scheduled use.
Making Generalizations That Might Hold True Under Similar Circumstances; Applying Problem-Solving Process to Other Real Problems	• Students who have drawn graphs to display data in one instance more readily draw graphs in other instances. • Students working on Play Area Design and Use apply skills they have acquired to their work on Mass Communications. • See also SCIENCE list: *Generalizing/Applying Process to New Problems.* • See also SOCIAL SCIENCE list: *Generalizing/Applying Process to Daily Life.*

ACTIVITIES IN PLAY AREA DESIGN AND USE UTILIZING MATHEMATICS

Basic Skills

Classifying/Categorizing	• Categorizing characteristics or properties of construction materials. • Categorizing characteristics of construction materials in more than one way. • Distinguishing sets and subsets of quantitative survey data on preferred play activities and equipment. • Using the concepts of sets (subsets, unions, intersections) for determining the arrangement of the play area based on student preferences and data on equipment. • Establishing categories, such as tall, medium, short for height data, when determining whether equipment is appropriate for a given student size. • See also SCIENCE list: *Classifying.* • See also SOCIAL SCIENCE list: *Observing/Describing/Classifying.*
Counting	• Counting votes to decide which play area problem to work on first. • Counting survey data or questionnaire data on preferences for play activities or equipment. • Counting the number of people who use different pieces of equipment at certain times of the day. • Counting to read scales on measuring instruments, such as meter stick, weighing scales. • Counting by sets to find scales for graph axes. • Counting the number of minutes different children use different pieces of equipment.
Computation Using Operations: Addition/Subtraction	• Adding one-, two-, or three-digit whole numbers to find the total tally of children using the play area or the total measurement of the available space. • Adding minutes and seconds when timing how long it takes people to use the slide. • Subtracting distance measurements to see how much room is left after game courts are painted on a concrete section of the play area. • Subtracting one-, two-, or three-digit whole numbers to find ranges for height data.

Computation Using Operations: Addition/Subtraction (cont.)	• Subtracting one-, two-, or three-digit whole numbers to find measurement differences between students in the class, between students in different grade levels. • Subtracting one-, two-, or three-digit whole numbers to determine the amount that measurements deviate from the median or mean measurement. • Subtracting one-, two-, or three-digit whole numbers to find ranges for graph axes, for measurement data, or to compare sets of data.
Computation Using Operations: Multiplication/Division	• Using multiplication and division to increase or decrease measurements for scale drawings or scale models. • Multiplying whole numbers to find the total measurement of materials needed to construct proposed equipment. • Multiplying or dividing to find a scale for graph axes. • Multiplying and dividing one-, two-, or three-digit whole numbers to convert from one unit of measure to another, such as meters to centimeters, inches to feet and vice versa. • Dividing to calculate ratios, fractions or percentages, such as amount of use per square meter, cost per person using equipment. • Dividing one-, two-, or three-digit whole numbers to determine the mean height or mean weight.
Computation Using Operations: Fractions/Ratios/Percentages	• Using mixed numbers to perform calculations, such as determining measurements of the play area. • Changing fractions to higher or lower terms (equivalent fractions) to perform calculations, such as calculating dimensions for play area equipment. • Using fractions and ratios to convert from one unit of measure to another, such as centimeters to meters. • Calculating percentages, such as the percentage of students who prefer one type of equipment to another. • Using ratios to increase or decrease measurements for a scale drawing of the play area or a scale model of a piece of equipment. • Using fractions in measurement, graphic comparisons, scale drawings, or scale models. • Calculating actual measurements from scale drawings using the ratio of the scale drawing. • Using slope diagrams to compare ratios and fractions, such as comparing the space equipment takes up with the number of children who can use it at a given time.

Computation Using Operations: Business and Consumer Mathematics/ Money and Finance	• Adding, subtracting, multiplying, and dividing dollars and cents to analyze costs of building play area equipment. • Gaining experience with finance: sources, uses, and limitations of revenues for improving the play area. • Using comparison when shopping for materials. • Using slope diagram to compare cost of each piece of equipment vs. use.
Measuring	• Converting from one unit of measure to another, such as meters to centimeters. • Using standard (centimeters, meters) and nonstandard (string lengths) units of measure to determine the dimensions of a play space. • Reading meter sticks or other measuring divices accurately. • Timing--using a wristwatch--how long different children must wait to use certain pieces of equipment. • See also SCIENCE list: *Measuring/Collecting, Recording Data.* • See also SOCIAL SCIENCE list: *Collecting, Recording Data/Measuring.*
Comparing	• Comparing quantitative data, such as measurements obtained by using a meter stick and a tape measure. • Using the concept of *greater than* and *less than* in making comparisons. • Comparing the mean, mode, and median of measurement data. • Comparing qualitative with quantative data, such as the appearance of the play area (large, small) with its actual measurements. • Comparing estimated or predicted measurements with actual play area measurements. • Comparing fractions and ratios using a slope diagram. • Comparing data graphically, such as a histogram showing the number of students with various knee-to-floor measurements. • See also SCIENCE list: *Analyzing, Interpreting Data.* • See also SOCIAL SCIENCE list: *Analyzing, Interpreting Data.*
Estimating/Approximating/Rounding Off	• Estimating the number of people who would use a piece of play equipment if purchased. • Estimating measurements of the play area, size of equipment, the amount of space needed for a certain game, or the cost of specific pieces of equipment.

Estimating/Approximating/Rounding Off (cont.)	• Determining when a measurement is likely to be accurate enough for a particular purpose, for example, accuracy required in measuring the dimensions of the play area for a scale drawing. • Rounding off measurements while measuring various body parts. • Rounding off data after measuring dimensions of the play area or a piece of play apparatus. • Using approximation in constructing play equipment.
Organizing Data	• Tallying on bar graphs or histograms. • Ordering real numbers on a graph axis. • Ordering measurements of floor-to-knee length from smallest to largest. • Ordering inches, feet, yards or centimeters, meters. • See also SCIENCE list: *Organizing, Processing Data*. • See also SOCIAL SCIENCE list: *Organizing, Processing Data*.
Statistical Analysis	• Interpreting bar graphs, histograms. • Determining total range of body measurement data. • Finding and comparing the median in an ordered set of measurement data, such as weight and height data. • Recognizing a pattern in the distribution of measurements collected from a large number of people. • Assessing predictability of a larger sample (all intermediate-grade children) based on results from a smaller sample (one class of intermediate-grade children). • See also SCIENCE list: *Analyzing, Interpreting Data*. • See also SOCIAL SCIENCE list: *Analyzing, Interpreting Data*.

Graphing	• Using alternative methods of displaying data, for example, charts and graphs.
	• Making a graph form--dividing axes into parts, deciding on an appropriate scale.
	• Representing data on graphs.
	    • Bar graph--number of children using various pieces of equipment during a certain time period.
	    • Conversion graph--converting meters to feet to purchase wood for construction of equipment.

Graphing (cont.)

- Cumulative distribution graph--total number of students who used the play area for certain lengths of time or less.
- Histogram--different number of children who use the play area for certain lengths of time.
- Line chart--use of various pieces of equipment according to grade level.
- Line graph--time spent waiting in line for a slide vs. the length of the line.
- Scatter graph--the grade level of a class vs. the amount of time the class spends on the play area.
- Slope diagram--the ratio of space required by different pieces of equipment to usage of it during recess.

- Obtaining information from graphs.
- See also SCIENCE list: *Communicating, Displaying Data.*
- See also SOCIAL SCIENCE list: *Communicating, Displaying Data.*

Spatial Visualization/Geometry

- Drawing or constructing a design or model of a piece of play equipment.
- Using geometric figures to understand and utilize relationships such as area to perimeter for the play area.
- Using stand mensurational formulas, for example, A = L x W (Area = Length x Width).
- Measuring and constructing scale layouts using rulers, compasses, and protractors.
- Using spatial arrangements to convey information on the best arrangement of equipment/game areas on the playground.
- Making a flow diagram of traffic patterns that develop during times of heavy use on the play area.

Areas of Study

Numeration Systems

- Using the decimal system in measuring play area dimensions for a scale drawing.
- Using fractions in measuring the area to be covered by a piece of equipment.
- Using the decimal system in calculating costs of materials such as paint, lumber, small equipment.

Number Systems and Properties

- See *Computation Using Operations.*

Denominate Numbers/Dimensions	• See *Measuring*.
Scaling	• Finding an appropriate scale (proportion) for the scale drawing or scale model. • Using a scale to draw and make representations in the scale drawing or scale model. • Making a scale drawing of the play area or a scale model of play equipment. • Deriving information from scale drawings of the play area and scale models of equipment.
Symmetry/Similarity/Congruence	• See *Spatial Visualization/Geometry*.
Accuracy/Measurement Error/Estimation	• See *Measuring* and *Estimating/Approximating/Rounding Off*.
Statistics/Random Processes/ Probability	• See *Statistical Analysis*.
Graphing/Functions	• See *Graphing*.
Fraction/Ratio	• See *Computation Using Operations: Fractions/Ratios/ Percentages*.
Maximum and Minimum Values	• Minimizing cost in recommending changes in the design of the play area. • Maximizing usage of space in recommending changes in the arrangement of the play area.
Equivalence/Inequality/Equations	• See *Comparing* and *Computation Using Operations*.
Money/Finance	• See *Computation Using Operations: Business and Consumer Mathematics/Money and Finance*
Set Theory	• See *Classifying/Categorizing*.

ACTIVITIES IN PLAY AREA DESIGN AND USE UTILIZING SCIENCE

Process

Observing/Describing

- Observing and describing the physical arrangement of the play area.
- Observing and describing use of the play area by children of different ages.
- Observing that accidents occur in overcrowded areas.
- See also SOCIAL SCIENCE list: *Observing/Describing/ Classifying.*

Classifying

- Classifying play according to the type of activity it is, for example, the jungle gym and circular ladder climb both provide opportunity for climbing.
- Determining which portions of the play area are heavily used and which are not.
- See also MATHEMATICS list: *Classifying/Categorizing.*
- See also SOCIAL SCIENCE list: *Observing/Describing/ Classifying.*

Identifying Variables

- Identifying the usage, cost, and space occupied as variables to be considered in selecting pieces of equipment.
- Identifying the number of children who use each piece of equipment as one of the things to be measured.
- Identifying the age of the children as one of the things to be controlled.
- Identifying scheduling and arrangement as two of the things to be changed to improve the play area.
- See also SOCIAL SCIENCE list: *Identifying Problems/ Variables.*

Defining Variables Operationally

- Defining the area taken up by the swings as that which extends one meter beyond the supports and includes the distance (arc) traveled by the swings.
- Defining the usage as the number of students who use the equipment in one recess period.
- Defining the length of the play area as the number of clicks of the trundle wheel rolled along one side of the perimeter of the space.

Manipulating, Controlling Variables/Experimenting

- Collecting measurement and/or usage data according to specified procedures.
- Changing the arrangement of the play area without changing the scheduling.
- Comparing usage and space of pieces of equipment that cost the same amount.
- Testing each equipment design model for overall strength and stability.
- See also SOCIAL SCIENCE list: *Manipulating, Controlling Variables/Experimenting.*

Designing and Constructing Measuring Devices and Equipment

- Designing and constructing measuring instruments in the Design Lab, for example, trundle wheels, meter sticks.

Inferring/Predicting/Formulating, Testing Hypotheses/Modeling

- Inferring from a histogram that certain "rung distances" will be appropriate for all the students in the school.
- Hypothesizing that the total usage of the play area will be increased if certain changes in arrangement are made.
- Making scale layouts of different possible play area arrangements to determine which best suits their need.
- See also SOCIAL SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*

Measuring/Collecting, Recording Data

- Measuring the play area in order to construct a scale layout.
- Measuring the space taken up by pieces of equipment.
- Measuring distance from floor to knee with meter sticks; reading results accurately.
- Tallying the number of students who use each piece of equipment.
- Recording measurements in an organized manner.
- See also MATHEMATICS list: *Measuring.*
- See also SOCIAL SCIENCE list: *Colelcting, Recording Data/Measuring.*

Organizing, Processing Data

- Ordering play area usage data according to time of day and day of week.
- Tabulating measurements of the play area and the equipment before constructing a scale layout.
- See also MATHEMATICS list: *Organizing Data.*
- See also SOCIAL SCIENCE list: *Organizing, Processing Data.*

Analyzing, Interpreting Data	• Calculating the average use of certain pieces of play equipment during recess for the entire week. • Analyzing data on cost, space, and usage of equipment to determine best arrangement for play area. • See also MATHEMATICS list: *Comparing; Statistical Analysis; Opinion Surveys/Sampling Techniques; Graphing; Maximum and Minimum Values.*
Communicating, Displaying Data	• Reporting data to the class. • Representing quantitative data on graphs or charts. • See also MATHEMATICS list: *Graphing.* • See also SOCIAL SCIENCE list: *Communicating, Displaying Data.* • See also LANGUAGE ARTS list.
Generalizing/Applying Process to New Problems	• Using knowledge acquired from working on one aspect of the play area to help solve other problems associated with play area design and use. • Applying skills acquired from work on Play Area Design and Use to work on Mass Communications or other USMES units. • See also SOCIAL SCIENCE list: *Generalizing/Applying Process to Daily Life.*

Areas of Study

Measurement	• Understanding the concept of a unit of measure. • Selecting the best instrument to use to measure large distances, body parts, and equipment, e.g., tape measure, meter stick, weight scales. • Measuring the amount of space required for various pieces of play equipment. • Measuring perimeter of play area using trundle wheels. • Using stopwatch to measure waiting times at various pieces of equipment. • See also MATHEMATICS list: *Measuring.*
Motion	• Observing that the force of one child pushing another on a swing is transformed into the motion of a swing. • Observing that a bigger force applied to a ball results in the ball travelling faster and farther.

Circular Motion

- Observing that the back-and-forth motion (force) of pushing a merry-go-round is transformed into the circular motion of the merry-go-round.
- See also Force.

Force

- Observing that more force is needed to start or stop a heavier person or object than a lighter one.
- Observing that it requires force to start or stop a swing, throw or catch a ball.
- Observing that force can be multiplied by using a lever, as when batting a ball.
- Observing the differences between power and manual tools when making measuring instruments in the Design Lab; observing that power tools multiply force or increase speed.
- Observing that force must be exerted to hammer nails into wood, noting that the hammer multiplies the force that is exerted.
- See also Motion.

Centripetal Force

- Observing that an inward force is required to make a jump rope move in a circular path. The force required is greater the heavier or longer the jump rope is.
- Observing that one tends to fall outward when riding on a merry-go-round because the merry-go-round pulls one's body from a straight-line path; observing that this tendency increases as the speed of the merry-go-round increases.

Momentum/Inertia

- Observing that objects at rest do not move until a force acts upon them.
- Observing that swings take longer to stop if they are going faster (the momentum is greater).
- Observing that when two people or objects collide, part of the momentum of one object is transferred to the other object.
- Observing that when a ball is batted, the momentum of the swinging bat is transferred to the ball.

Friction

- Observing that swings stop eventually because of the frictional force exerted by the air and by the swing support.

Friction (cont.)	• Observing that the smoother the slide is, the faster a person goes down it. • Observing that a blade becomes warm when vigorously sawing a piece of wood because doing work against the force of friction generates heat.
Weight	• Observing that play equipment must be stronger to support more weight. • Observing that persons light in weight must sit farther from the center of a seesaw to balance a heavier person. • Observing the higher a slide is, the faster a person goes because his/her weight is exerting a force over a longer period of time.
Mechanical Work and Energy	• Observing that mechanical work and energy are involved in using play area equipment, for example, pumping one's legs while swinging enables one to go higher. • Observing that hitting a ball harder (exerting a greater force) requires more work and energy. • Observing that saber saws are faster than hand saws for cutting Tri-Wall or lumber and that they transform electrical energy into mechanical energy. • See also Motion and Force.
Solids, Liquids, and Gases	
States of Matter	• Observing that glue is available in liquid or solid form with different properties. • Observing that a solid stick of glue is turned into hot liquid glue by using a hot glue gun.
Properties of Matter	• Observing the effects of physical and chemical wear on materials, for example, rusting of metal play equipment, wearing out of seat swing, wearing off of paint. • Investigating the effects of time and weather on materials. • Observing that different construction materials, such as lumber and Tri-Wall have different properties that make them useful for different tasks. • Observing that different ground covers such as grass or concrete have different properties that make them useful for different activities.

Ecology/Environment	• Recognizing that utilizing space for a play area affects other aspects of the environment, such as walkways, trees, shrubs. • See also SOCIAL SCIENCE list: *Geography/Physical Environment*.
Anatomy/Physiology	• Measuring various body parts, such as height, knee-to-floor. • Recognizing that differences in human proportions necessitate different equipment dimensions, for example, swings at several heights from the ground, climbing apparatus with differently spaced ladder rungs, size and weights of baseball bats, space needed for a baseball field.

ACTIVITIES IN PLAY AREA DESIGN AND USE UTILIZING SOCIAL SCIENCE

Process	
Observing/Describing/Classifying	• Organizing and classifying sets of ideas, activities, or information. • Observing and describing difficulties resulting from scheduled use of the play area. • Classifying play area problems. • Describing the various behaviors of children on the play area that cause accidents. • See also MATHEMATICS list: *Classifying/Categorizing.* • See also SCIENCE list: *Observing/Describing; Classifying.*
Identifying Problems, Variables	• Identifying different attitudes students have toward their play area. • Identifying problems with the play area. • See also SCIENCE list: *Identifying Variables.*
Manipulating, Controlling Variables/ Experimenting	• Standardizing measuring methods among the students. • Conducting trials on use of the play area with revised scheduling without changing physical arrangement of the space; comparing this data with that collected before changes were made. • See also SCIENCE list: *Manipulating, Controlling Variables/Experimenting.*
Inferring/Predicting/Formulating, Testing Hypotheses	• Inferring from results of opinion surveys the types of play activities that should be planned. • Hypothesizing that rescheduling the use of the play area will reduce overcrowding. • Conducting trials based on new/different schedules to determine whether solution makes a difference. • Choosing best method of play area scheduling. • See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*
Collecting, Recording Data/Measuring	• Using voting procedure to determine preferences. • See also MATHEMATICS list: *Counting; Measuring.* • See also SCIENCE list: *Measuring/Collecting, Recording Data.*

Organizing, Processing Data	• Tallying votes for types of activities to offer on the play area. • Tallying opinion survey or questionnaire data on attitudes towards play area before and after changes have been made. • Ordering results of opinion survey on preferred equipment from most popular to least popular. • See also MATHEMATICS list: *Organizing Data*. • See also SCIENCE list: *Organizing, Processing Data*.
Analyzing, Interpreting Data	• Comparing quantitative data such as survey results. • Comparing qualitative information gathered from various sources, such as consumer information on different brands of the same equipment. • Evaluating the way the opinion survey was administered, the size and makeup of the sample. • Comparing data obtained from different groups of people or from samples of different size. • Analyzing data on scheduling and usage to determine a better possible schedule. • See also MATHEMATICS list: *Comparing; Statistical Analysis; Opinion Surveys/Sampling Techniques; Graphing; Maximum and Minimum Values*. • See also SCIENCE list: *Analyzing, Interpreting Data*.
Communicating, Displaying Data	• Reporting group activities to the class. • Representing survey data, such as preferences about play equipment, on graphs or charts. • Making charts or graphs that can be easily understood and will have maximum impact on intended audience, e.g., principal or school board. • See also MATHEMATICS list: *Graphing*. • See also SCIENCE list: *Communicating, Displaying Data*. • See also LANGUAGE ARTS list.
Generalizing/Applying Process to Daily Life	• Using the knowledge acquired from improving one aspect of the play area to help solve other associated play area problems, such as storage and distribution of small equipment. • Applying one's knowledge of opinion surveys to surveys on other problems. • Offering suggestions for improving public playgrounds to city park authorities. • See also SCIENCE list: *Generalizing/Applying Process to New Problems*.

Attitudes/Values

Accepting Responsibility for Actions and Results	• Making sure that various tasks, such as measuring the play area, duplicating survey forms, are done. • Scheduling hours and people to collect data on the playground or to administer opinion surveys to various classes. • Scheduling and giving presentations to persons in authority, such as the principal, to obtain approval for proposed changes on the play area.
Developing Interest and Involvement in Human Affairs	• Promoting changes on the play area to reduce overcrowding and accidents and increase the enjoyment of it by schoolmates.
Recognizing the Importance of Individual and Group Contributions to Society	• Recognizing that they can improve conditions on their play area. • Recognizing that their improvement of the play area will help the whole school as well as themselves. • Assessing the effects of group action on school regulations and schedules.
Developing Inquisitiveness, Self-Reliance, and Initiative	• Conducting group sessions with help from the teacher. • Dealing with various merchants to obtain supplies, for example, construction materials. • Finding their own solutions to problems encountered in addition to the main problem of the challenge. • Choosing and developing the best way of presenting a plan to the principal. • Learning to use different ways of obtaining needed information, for example, writing letters or using the telephone.
Recognizing the Values of Cooperation, Group Work, and Division of Labor	• Finding that work on improving the play area progresses more rapidly and smoothly when they work in groups. • Eliminating needless overlap in work. • Finding that work is more fun and proceeds more smoothly when people cooperate.
Understanding Modes of Inquiry Used in the Sciences, Appreciating their Power and Precision	• Using scientific modes of inquiry to investigate and solve play area problems. • Using data, graphs, and other supportive material to convince other people that a proposed solution be accepted.

Understanding Modes of Inquiry Used in the Sciences, Appreciating Their Power and Precision (cont.)	• Seeing that various play area arrangements can be tried by using scale layouts. • See also MATHEMATICS and SCIENCE lists.
Respecting the Views, Thoughts, and Feelings of Others	• Considering all suggestions and assessing their merits. • Considering the opinions of others when proposing a change; conducting opinion surveys to help determine which small equipment should be purchased. • Recognizing differences in values according to age, experience, occupation, income, interests, culture, race, religion, ethnic background. • Recognizing core values of daily living: fair play and justice, free speech, opportunity for decision making, opportunity for self-respect, freedom of choice, right to privacy, acceptance of the life styles of the community, group identity.
Being Open to New Ideas and Information	• Considering ideas and suggestions from other students as well as other ways of doing various tasks. • Recognizing the importance of information obtained from different sources, such as, fire department, catalogs, opinion survey data, principal.
Learning the Importance and Influence of Values in Decision Making	• Realizing that preferences for various play area arrangements reflect the values of each individual, as in deciding whether to use some of a grassy area for a piece of playground equipment.

Areas of Study

Economics *	• Investigating costs of equipment for play area use vs. use of equipment and budget restrictions. • Gaining experience in record keeping and comparative shopping for materials, retail and wholesale prices, discounts. • Gaining experience with finance: sources, uses, and limitations of revenues for the purchase of play area equipment. • Assessing preferences, characteristics, etc., of users (i.e., classmates) through surveys or questionnaires.

Geography/Physical Environment	• Investigating and changing the physical environment of the play area. • Making and using maps of the play area, school grounds, etc. • Observing that people behave differently in different environments. • Recognizing that redesigning the physical environment changes the way people use it and interact with one another in it.
Political Science/Government Systems	• Establishing rules for use of the play area. • Investigating systems of administration and control. • Investigating regulations and policies affecting planned changes on the play area. • Getting in touch with and working with school authorities to obtain permission to carry out play area improvements.
Recent Local History	• Investigating previous attempts to change the play area. • Investigating previous ownership and use of land.
Social Psychology/Individual and Group Behavior	• Recognizing and using different ways of approaching different groups, for example, a presentation to schoolmates would be different than one to the PTA of the school. • Recognizing the need for leadership within small and large groups; recognizing differing capacities of individuals for various roles within groups. • Analyzing the effects of a small group making decisions for a larger group.
Sociology/Social Systems	• Considering the integral, related nature of a community and its physical or recreational surroundings as a factor in the problem of making the play area a better place. • Devising a system of working cooperatively in small and large groups. • Investigating problems and making changes that affect not only themselves but society--other students in the school, people in the community. • Working within established social systems to promote changes on the play area.

Sociology/Social Systems (cont.)

- Experiencing and understanding differences in social systems in different social groups (children and adults, women and men).
- Recognizing that there are many different social groups and that one person belongs to more than one.

ACTIVITIES IN PLAY AREA DESIGN AND USE UTILIZING LANGUAGE ARTS

Basic Skills

Skill	Activities
Reading: Literal Comprehension--Decoding Words, Sentences, and Paragraphs	• Decoding words, sentences, and paragraphs while reading catalogs of play area equipment; while reading school schedules and regulations; while reading drafts of proposals, presentations, letters.
Reading: Critical Reading--Comprehending Meanings, Interpretation	• Obtaining factual information about play area equipment, first aid, etc. • Understanding what is read about play area equipment, first aid, drafts of proposals to change play area design and/or use.
Oral Language: Speaking	• Offering ideas suggestions, and criticisms during discussions in small group work and class discussions on problems and proposed solutions. • Reporting to class about data collection, scale drawing activities, construction, etc. • Responding to criticisms of activities. • Preparing, practicing, and giving effective oral presentation to principal or PTA requesting funds to improve the play area or permission to make changes. • Using the telephone properly and effectively to obtain information or to invite a resource person to speak to the class. • Conducting opinion surveys about possible play area activities. • Using rules of grammar in speaking.
Oral Language: Listening	• Conducting interviews of schoolmates. • Following spoken directions. • Listening to group reports.
Oral Language: Memorizing	• Memorizing portions of oral presentations.
Written Language: Spelling	• Using correct spelling in writing.

Written Language: Grammar--Punctuation, Syntax, Usage	• Using rules of grammar in writing.
Written Language: Composition	• Writing to communicate effectively: • preparing written proposals and letters using notes, data, graphs, charts, etc., communicating need for proposed play area changes. • preparing writeups of play area rules to go with new or old play equipment. • writing posters of new rules for the play area. • writing opinion surveys for schoolmates, devising questions to elicit desired information; judging whether a question is relevant and whether its meaning is clear.
Study Skills: Outlining/Organizing	• Taking notes when consulting authorities or books about play equipment design and construction, safety, regulations. • Developing opinion survey; ordering questions around central themes, such as preferences for play activities. • Planning presentations, data collection schemes, etc. • Organizing ideas, facts, data for inclusion in reports/proposals to other groups or presentation to principal or PTA.
Study Skills: Using References and Resources	• Using the library to research information on equipment design, construction, fire and safety regulations, etc. • Using the dictionary to locate words. • Finding an expert in physical design and use of space and inviting him or her to speak to the class and answer questions for them. • Using indexes and tables of contents of books to locate desired information. • Using "How To" Cards for information on making a scale drawing, using tools, etc.
Attitudes/Values	
Appreciating the Value of Expressing Ideas Through Speaking and Writing	• Finding that classmates and teacher may approve of an idea if it is presented clearly. • Finding that the school will allocate money when presented with an adequate (written or oral) proposal.

Appreciating the Value of Written Resources	• Finding that certain desired information can be found in catalogs and other books on available play equipment designs, costs, and regulations.
Developing an Interest in Reading and Writing	• Willingly looking up information on equipment designs, construction, costs, regulations, etc. • Looking up further or more detailed information. • Showing desire to work on drafting letters, reports, or proposals.
Making Judgments Concerning What is Read	• Deciding whether what is read is applicable to the particular problem. • Deciding how reliable the information obtained from reading is. • Deciding whether the written material is appropriate, whether it says what is is supposed to say, whether it may need improvement.
Appreciating the Value of Different Forms of Writing, Different Forms of Communication	• Finding that how information can be best conveyed is determined in part by the audience to whom it is directed. • Finding that certain data or information can be best conveyed by writing it down, preparing graphs or charts, etc. • Finding that certain data or information should be written down so that it can be referred to at a later time. • Finding that spoken instructions are sometimes better than written instructions, and vice versa.