DOCUMENT RESUME

ED 220 322 SE 039 084

AUTHOR Agro, Sally
TITLE Using Free Time - USMES Teacher Resource Book. Second 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-0-89292-024-6
PUB DATE 77
GRANT SED-69-01071
NOTE 233p.; 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 ($5.75).

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Elementary Education; *Elementary School Mathematics; *Elementary School Science; Interdisciplinary Approach; Language Arts; Learning Activities; *Leisure Time; Mathematics Education; Outdoor Activities; *Problem Solving; Process Education; Resource Materials; Science Course Improvement Projects; Science Education; Social Studies; Student Projects; Teaching Guides; Teaching Methods; *Unified Studies Curriculum
IDENTIFIERS National Science Foundation; *Unified Science Mathematics for Elementary Schools

ABSTRACT

Finding educational, useful, or fun things to do during recess or lunchtime 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, flow charts illustrating how investigations evolve from students' discussions of the problems, and a hypothetical account of intermediate-level class activities. Section III provides documented events of actual class activities from grades 3, 4, 5, and 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

This Edition of Using Free Time:

Written and edited by Sally Agro
Supervising editors: Betty M. Beck, L. Ray Brady, Jr.
Production work: Sally Agro, L. Ray Brady, Jr., Martha Allegro, Paula Lakeberg
Production assistants: Paula Santillo, Peter Zevitas, Nancy Brady
Cover and title page: John W. Saalfield

University Content and Curriculum Specialists

Leland Webb, California State College

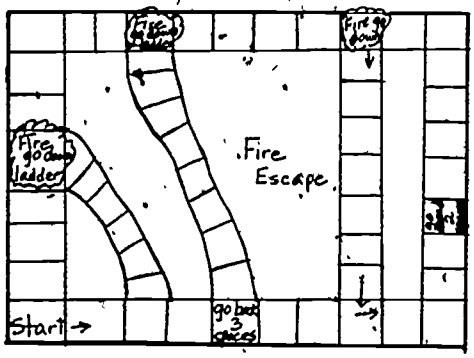
Classroom Teachers

Susan Bunnell, Minneapolis, MN
Joy Clarke, Boulder, CO
Cathy Daane, Eaton Rapids, MI
Peggy Dal Porto, Boulder, CO
Sandra Every, Merion, PA
Robert Farias, Lexington, MA
Elizabeth Gilpatrick, Boulder, CO
Charlotte Hayes, Eaton Rapids, MI
Patty Howell, Portland, OR
Michael Kingston, Urbana, IL
Jeanette Lea, Washington, DC
Marion Perkins, Athens, GA
Laura Rodriguez, Austin, TX
Marie Salah, Watertown, MA
Dianne S. Smith, Charleston, SC
Sandra Szedlak, Lansing, MI
Yvonne Thorne, Washington, DC
Peggyanne Whitley, Washington, DC

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 be possible. Many thanks to Margery Koo Bussey who wrote and edited the previous edition and to the Planning Committee for their years of service and advice. Special thanks also go to other members of the USMES staff, especially to Charles Donahoe for coordinating Design Lab activities and Lois Finstein for organizing development workshops.

This book is a resource developed by the USMES Project: Earle L. Lomon, Project Director, Betty M. Beck, Associate Director for Development, Thomas L. Brown, Associate Director for Utilization Studies, Quinton E. Baker, Associate Director for Administration.

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



Name: Fire Escape
OBJECT of the game:
The person who goes around the board first wins. Equipment: board, 6 markers, 2 dice The play:
6 players
1. Throw the dice
2. lowest number goes first
3. Shake the dice and move that number of spaces
4. If land on the fire, must move down the ladder.

Using Free Time

Second Edition

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

Trial Edition

Complete USMES Library ISBN: 0-89292-033-5
Using Free Time ISBN: 0-89292-024-6
Education Development Center, Inc., Newton 02160

Printed in the United States of America

CHALLENGE: FIND THINGS TO DO DURING YOUR _____ (RECESS TIME, LUNCHTIME) THAT WOULD BE _____ (EDUCATIONAL, USEFUL, FUN).

Table of Contents

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 kindergarten 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.

USMES Resources

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. In addition USMES provides resources for both teachers and students. A complete set of all the written materials comprise the USMES library, which should be available in each school using USMES units. These materials include--

1. *The USMES Guide*: This book is a compilation of materials that may be used for long-range planning of a curriculum that incorporates the USMES program. It describes the USMES project, real problem solving, classroom strategies, the Design Lab, the units, and the support materials as well as ways that USMES helps students learn basic skills.

2. *Teacher Resource Books* (one for each challenge): Each of these guides to using USMES units describes a broad problem, explains how students might narrow that problem to fit their particular needs, recommends classroom strategies, presents edited logs from teachers whose classes have worked on the unit, and contains charts that indicate basic skills, processes, and areas of study that students may learn and utilize.

3. *Design Lab Manual*: This guide helps teachers and administrators set up, run, and use a Design Lab--a place with tools and materials in which the students can build things they need for their work on USMES. A Design Lab may be a corner of a classroom, a portable cart, or a separate room. Because many "hands-on" activities may take place in the classroom, every USMES teacher should have a Design Lab Manual.

4. *"How To" Series*: These student materials provide information to students about specific problems that may arise during USMES units. The regular *"How To" Series* covers problems in measuring, graphing, data handling, etc., and is available in two versions--a series of

cartoon-style booklets for primary grades and a series of magazine-style booklets with more reading matter for upper grades. The *Design Lab "How To" Series* is available in two illustrated card versions--one for primary grades and one for upper grades. A complete list of the *"How To" Series* can be found in the *USMES Guide*.

5. *Background Papers*: These papers, correlated with the *"How To" Series*, provide teachers with information and hints that do not appear in the student materials. A complete list can be found in the *USMES Guide*.

6. *Curriculum Correlation Guide*: By correlating the twenty-six USMES units with other curriculum materials, this book helps teachers to integrate USMES with 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, 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.

* * * * *

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 suppliers of 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 Using Free Time

1. OVERVIEW OF ACTIVITIES

Challenge:

Find things to do during your _____ (recess time, lunchtime) that would be _____ (educational, useful, fun).

Possible Class Challenges:

How can we make recess time more enjoyable?

Plan some activities for the time after lunch that everyone will enjoy.

Plan things for you and others to do during recess on rainy days.

The problem of what to do during free time in the school day, such as during indoor recess or after finishing lunch, has always been a concern for students. Given the opportunity, they will suggest many different activities for free time.

The challenge may arise naturally in many situations: after indoor recess has been held for several days; when children find that they have extra time after completing their work each day; or when the class complains they have nothing to do during lunch period. The challenge may also arise from work on another USMES challenge. For example, a class working on the Play Area Design and Use challenge may decide to organize an outdoor recess program for various grade levels in the school.

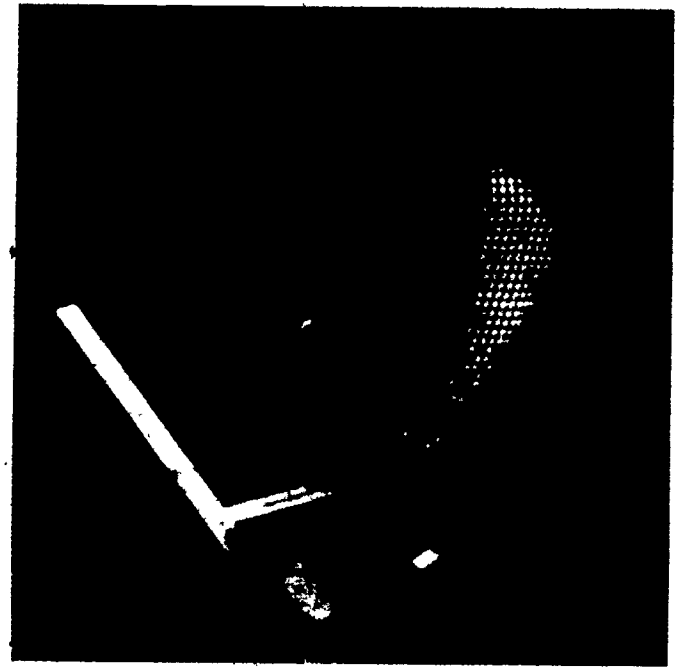
Once the challenge has been introduced, the children may survey their class or the whole school to determine what they do when they have free time, and what they would like to do during this free time. After analyzing the survey results, the class may determine the most popular free-time activities and begin work on these first. Some children may interview the principal and/or other school personnel, such as the art teacher, or gym instructor, to obtain information such as which extra rooms are available for free-time activities, the school rules for using these areas, the availability of the art room or gym, or possibilities for outdoor activities.

Some classes may design new games. They may first discuss different types of games that could be made, such as card games, dice games, board games, active indoor or outdoor games, team games, or educational games. The class may then survey others to find out what types of games are preferred. In designing their games, they may consider possible game rules, the fairness of the game, the equipment required, the number of people who can play, and the amount of space needed. In considering the fairness of their games, some classes may experiment with various replacements for dice in their games. Once students have constructed their games, they may keep them for use in their own classroom, lend or teach the games to others in the school, or sell the games or game plans to others. When using the games with others, students often lend them for a trial

period and then evaluate their use by an opinion survey or questionnaire.

Other students may organize a music or art center to be used during various times in the school day. After conducting a survey to determine preferences for music or art projects, the students may investigate and secure a room for the center, obtain needed music or art equipment, prepare rules and a schedule for the center, and investigate ways to secure the equipment from vandalism. Training sessions on use of the equipment may be held for potential users of the center. Once it is set up, the class may open the center for a trial period. During this time, the children may collect data through surveys and observation of those using the center.

Most classes working on Using Free Time evaluate the data they have collected during a trial period and make needed revisions in their games or center activities. After revisions have been made, students often again conduct surveys or make observations before they are satisfied that the challenge has been resolved.



The class may continue to work on the Using Free Time challenge by becoming involved in various school services such as supplying other classes with games related to school subject areas, setting up art shows or music programs for the school, tutoring, helping other teachers, or guiding visitors. Work on Using Free Time may also lead to work on other USMES challenges such as School Rules, Classroom Design, Classroom Management, Advertising, School Supplies, Protecting Property, Play Area Design and Use, Mass Communications, Manufacturing, and Consumer Research.

Although many of the activities in the Using Free Time unit 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 see 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 it or practicing it within real contexts as they count how many children prefer a certain game or how many games are needed in a class. In working on Using Free Time, children may also learn and practice measuring, graphing, working with decimals, and dividing. Although dividing seems necessary to compare fractions or ratios, primary children can make comparisions graphically instead. For example, when comparing the number of yes responses with total responses

to different questions on a survey, children can make slope diagrams of these ratios to see which question had the greatest percentage of yes responses.

2. CLASSROOM STRATEGY FOR USING FREE TIME

The Using Free Time unit centers on a challenge--a statement that says, "Solve this problem." Its success or failure in a classroom 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 Using Free Time challenge--"Find things to do during your_____(recess time, lunchtime) that would be_____(educational, useful, fun)"--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 Using Free Time challenge has been restated by some classes in terms of finding something for the class to do during recess on rainy days or in terms of organizing activities or a center during lunchtime for the whole school.

The Process of Introducing the Challenge

Given that a Using Free Time 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. However, USMES teachers have found that certain general techniques are helpful in introducing the Using Free Time challenge.

One such technique is to turn a spontaneous discussion of a recent event or activity toward the Using Free Time challenge. For example, the Using Free Time challenge may be introduced after children complain of being bored during indoor recess.

Fourth-grade students began designing and constructing board games after it became clear that chil-

dren were bored after eating lunch when they could not go out because of the weather. The children listed three reasons why children misbehaved during this time.

1. *Their teacher was not in their room.*
2. *The lunch aides were not strict enough.*
3. *There were no complete games to play.*

The children agreed they did not have any control over the first two situations but felt they could do something about the last.

A sixth-grade class, after learning they could not use the school gym during indoor recess, began investigating the total aspect of recess, outdoors as well as indoors. During the winter months they organized an outdoor sports program that included such activities as ice skating and sledding. All the activities were arranged by the children and supervised by the teachers.

The Using Free Time challenge may also evolve from other classroom discussions or work. For example, a class may become interested in setting up a hobby or art center in the school after discussing what children made over a vacation. Plans for the center would naturally incorporate discussions of when the children could use the center during school hours.

Often, work on one challenge leads to another. For example, the Using Free Time challenge may arise when classes become interested in organizing a total indoor/outdoor recess program after making improvements to the school playground in response to the Play Area Design and Use challenge. Other classes may become involved in organizing an art or a music center after learning during work on the School Rules challenge that it is against the school rules to go outside during lunch period without adult permission and supervision. Work on Classroom Management may also lead to the Using Free Time challenge if there are periods during the day when only part of the class is busy, perhaps in special classes.

In one combination fifth/sixth-grade class, students who had worked on a Classroom Design challenge

the previous year became involved in a Using Free Time challenge of rearranging the classroom to make space for an art center and a listening center.

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.

Classroom experience has shown that children's progress on the Using Free Time 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. This is particularly true if the challenge is treated as a series of projects rather than as a real problem. 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 is higher in classes that start work on the Using Free Time challenge by focusing on a specific area. To determine the most popular area of interest (e.g., games, outdoor activities, art center, music center), the class may first conduct a preliminary opinion survey. Classes attempting to work on more than one area at once may become disorganized and lose their focus. If a class, for example, attempts to design and construct games and set up an art center simultaneously, their investigations may be superficial and fragmented.

Initial Work on the Challenge

Once a class has decided to work on a Using Free Time 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.

Often the students begin by discussing the problem and suggesting possible solutions. The class may decide to conduct an opinion survey to determine if the problem exists for others or to determine which solution might be preferred by others.

One third-grade class, after constructing prototype games for themselves, decided to survey other classes

in their school to determine their game preferences. They then used the survey results to construct specific types of games for each of the other classes.

Experience has shown that the children's investigations of USMES challenges tend to go more smoothly with the cooperation of the school principal, staff, and other school personnel. Children working on the Using Free Time challenge may want first to inform the principal of their intentions of finding activities to do during indoor recess or lunch time. They may then determine what the school rules are for using various rooms in the building or for children leaving their classrooms.

Because one sixth-grade class wanted to investigate all aspects of recess, they agreed they needed to work cooperatively with the school administration and the local P.T.A. The class realized that additional activities in various places on the school grounds required altering teacher aide schedules in order to provide the proper supervision. The children sent word to the P.T.A. through their Student Council that they wanted more "things happening" during recess periods. The P.T.A. in turn met with the principal and constructive suggestions, such as winter outdoor sports, were acted on.

The children then set priorities for the tasks they consider necessary to the solution of the problem. Most of these tasks are carried out by small groups of children. It is important that priorities be set so that some groups do not become stalled in their progress because others have not completed their work.

A sixth-grade class working on setting up a music center formed five groups to work on various aspects of the problem simultaneously. Although the rules group was able to draw up some fairly practical rules, they found that they could go no further until a schedule (the responsibility of another group) for the center had been devised.

As various groups complete their work, their members join other groups or form new groups to work on additional tasks.

One third-grade class formed seven groups to work on various types of games. After the games had been completed and tested by the class, the children formed two new groups (1) to develop a questionnaire on game preferences of other children in the school and (2) to organize a test session of the completed games with another class. When these two activities were completed, the class decided to form new groups to make games for the classes that had filled out the questionnaire.

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 Using Free Time 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.

When students work on the Using Free Time challenge, they may fail to evaluate their games, center, or program, or they may not evaluate them carefully enough. Often students carry out more comprehensive investigations when they test how others feel about their solution to the problem by observations or opinion surveys.

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 the students

that the first person to move will always be the winner when playing a certain game, the teacher might ask, "Is this a fair game? How can you find out?" Other examples of non-directive, thought-provoking questions are listed in section B6.

When conducting an opinion survey on preferences for free time activities, students often fail to ask questions that will give them the information they need. By conducting the survey first within the classroom, they discover that questions with multiple-choice answers are usually more effective than questions with open-ended answers. In addition, when choosing a sample of students to respond to a survey, a class may find their sample is too small or is biased in some way. As a result, the survey may not indicate clearly which activities are preferred by most students. The teacher may wish to refer the students to the "How To" Cards *How to Choose a Sample for a Survey* and *How to Design and Analyze a Survey*. A list of those "How To" Cards pertinent to Using Free Time can be found in section D1.

If many students or even the entire class, need help in a particular area, the teacher should conduct skill sessions as these needs arise. (In addition to the "How To" Cards, Background Papers provide teachers with information on specific problems that might arise, such as how to design an opinion survey.)

When one class involved in making board games to use outside was ready to construct their games in the Design Lab, the teacher held a skill session on metric measurement. To gain practice in measuring, the children measured themselves with meter sticks and recorded their data. At a later session, the class used their newly-acquired measuring skills to measure Tri-Wall for their board games.

USMES teachers can also assist students by making it possible for them to carry out tasks involving hands-on activities. During work on the Using Free Time challenge, children may need to visit other classes to conduct opinion surveys or to test their games. The teacher can help, if needed, by talking with other teachers. 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 loca-

tion (in part of the classroom, on a portable cart, or in a separate room) can be called a Design Lab. A more detailed account of the Design Lab may be found in the USMES Guide.

Valuable as it is, a Design Lab is not necessary to begin work on the Using Free Time 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 sixth-grade class did not need to use the school's Design Lab in setting up a music center where students could go to study or listen to music. The class surveyed the school to determine music preferences, secured and taped the songs, set up the center in an available seminar room, and arranged a suitable schedule for use of the center.

The extent to which any Design Lab is used varies with different classes because the children themselves determine the direction of the investigations.

Culminating Activities

Students usually continue to work on the Using Free Time challenge until they have made progress in finding and implementing some solution to the challenge, such as effectively reducing the number of bored and restless children during recess time because of an art center where children may go to work on projects. They may then conduct a survey to determine whether their solution has solved the problem or whether making changes would result in further improvement. After evaluating the survey, the students may implement suggestions for improvement.

Classes working on the Using Free Time challenge often decide to continue by organizing further activities for free time. For example, after setting up an art or music center that can accommodate intermediate grades, the class may work on providing some sort of free time activities for the primary grades. A change in the season and temperature may result in the class's organizing different types of outdoor activities.

One sixth-grade's winter outdoor program was so successful that a spring program was instituted. Dur-

ing the winter activities, all the supervising teachers reported good behavior. Based on survey results, the class organized two softball leagues, and teachers were also invited to participate.

3. USE OF USING FREE TIME IN THE PRIMARY GRADES

Children in primary grades enjoy working on the Using Free Time challenge just as much as older children. Although their investigations may not be as detailed or sophisticated as those of older children, primary children can collect data by conducting surveys or measuring, interpret data by constructing bar graphs, and take effective action to meet their challenge.

When children are forced to stay inside for a long time because of bad weather, it is not long before they become bored. The problem of what to do during indoor recess or lunchtime is a problem that has no age limits. One second-grade class became angry because the lunch aides would not let them talk during lunch; they then were challenged by the classroom teacher to design games to use during lunch.

Once the children are involved with the challenge, the primary teacher may find that several short sessions every day are preferable to two or three extended periods each week. In this way, the children will not lose interest because of long periods of time between sessions.

Once a primary class has decided to work on a particular solution to using their free time, the class might discuss various aspects that need to be investigated and list them on the board. It may be better for the whole class to work, in the beginning, on one aspect at a time.

For example, if a class has decided to set up an art center in their room for use during free time, they may list the following aspects to be investigated:

1. Find best location in room for art center
2. Obtain needed materials
3. Arrange furniture and storage containers
4. Set up rules and schedule for use of center

As the children become more able to follow through on their proposed plans, the teacher might encourage the class to divide the various aspects of the problem among small groups. The small groups would then present their findings to the class for discussion. This sharing experience not only provides for the opportunity to practice oral skills but also allows the children to exchange ideas.

Primary children are able to work independently in groups much of the time, but the teacher should be aware of groups that may be having difficulty in developing a concrete plan of action, or whose work has become stalled because of unforeseen problems. Many times a short discussion with the group having difficulty will resolve the problem.

While many primary children do not possess fine motor coordination, they can, with planning and care, design and construct attractive games, art projects, or needed furniture for a center. When designing and constructing games, primary children often make a first draft on scrap paper before constructing a final version. This provides an opportunity for them to make corrections in spelling and layout and also provides the whole class with an opportunity to make suggestions for improvement.

The children may need assistance in obtaining information (such as prices) on the materials they need and in purchasing them. Although many primary children are capable of calling various stores, the teacher can help by making sure the children think about what they will say before they actually use the telephone. Sometimes it is helpful for a child to write down what he or she plans to say before calling. If the children need to purchase materials, the teacher can help by providing supervision during a shopping trip.

In the course of working on Using Free Time, the children will gain many important language arts skills as they prepare group reports for class discussions, write rules for games they have designed, write letters to parents when scrounging for materials for an art or music center, design surveys, and make posters and signs. One third-grade class spent considerable time writing clear game rules. The rules were rewritten several times before their classmates clearly understood them. Later, the class prepared a game book which included pictures of the various games they had made and the game rules.

Using Free Time also provides many opportunities for children to learn and practice counting and computational skills. In one primary class, children counted and recorded how many children in other classes preferred certain types of games from the responses on an opinion survey.

The children often see the need to survey their class or other classes to find out what activities they do presently during their free time or to determine what their favorite games are. The children decide what information they want and design a simple survey. If they want to survey other classes, they try out the survey first in their own class. When conducting an oral survey, the children often prepare an outline of what they are going to say. One third-grade class surveyed other classes to determine favorite games. Based on their survey data and the number of game requests, the class became involved in making games for these various classes.

Tallying and graphing are easily introduced to primary children as they see the need to organize and make pictures of their information. Bar graphs may be made in a variety of ways by primary children to enable them to make a clear connection between the data and the picture. Children may use a colored square of paper or a wooden block to represent each child and paste or stack them in columns representing different preferences for games. The tallest column will then show the most preferred type of game. Many times primary children do not realize clearly that one type of game is strongly preferred over another until they can see such a visual representation of the numbers.

Classroom experience has shown that small children are able to understand simple graphs and make decisions about the fairness of games or the use of games or centers based on these graphs. When primary children make board games requiring the use of dice, they often construct dice. In one primary class, the children decided whether their various-shaped dice were fair or not by recording results of the trials on a bar graph.

If the children want to find a "typical" number, such as the average time spent on a game, they can use the median instead. The median can be found by counting and is, in many cases, a better number to use. If there is a need to calculate and compare ratios or percentages, such as the percentage of children in different grades who prefer one game over another, then the children can make a slope diagram. This allows children to make a visual comparison of percentages.

Often, primary children see the need for some sort of a unit of measurement when they realize that visual approximations or measurements using different units are difficult to compare. Children in one third-grade class recognized the importance of measurement in relation to game fairness.

For example, in one bean-bag type game, to assure that every tosser stood the same distance from the box, a six-foot distance was measured and a line marked. Any player who crossed the line was automatically disqualified.

Past experience in many schools has shown that primary children are able to work in the Design Lab and can use the power tools with some adult assistance. In one third-grade class the children spent considerable time in the Design Lab constructing their games, frequently using the saber saw to cut Tri-Wall pieces or wooden dowels. Primary children working on other USMES challenges have designed and built tables, boxes, and plaques from Tri-Wall and lumber.

4. FLOW CHART

The following flow charts present some of the student activities—discussions, observations, calculations, constructions—that may occur during work on the Using Free Time challenge. Because each class will choose its own approach to the challenge, the 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; a class usually works on just one of the aspects represented by the several charts.

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 Using Free Time problem.

Challenge: Find things to do during your _____ (recess time, lunchtime) that would be _____ (educational, useful, fun).

Optional Preliminary Activities:

Need for something to do during free time.

Another USMES Unit:
- *School Rules*
- *Classroom Management*
- *Play Area Design and Use*

Possible Student Activities:

Class Discussion: What do you do when you have some free time (e.g., during recess time, lunchtime)? What do other students do during their free time? How can we improve existing activities? What would you *like* to do during your free time? What would others like to do? How can we find out?

Data Collection: Surveying class and/or school to determine when free time occurs, what students do or would like to do during their free time.

Data Collection: Observing classes to determine how students use their free time. Tallying results of observation.

Interviewing principal and/or others to determine possible activities, use of various areas, and school rules.

Data Representation: Displaying data on charts, bar graphs, line charts, and slope diagrams.

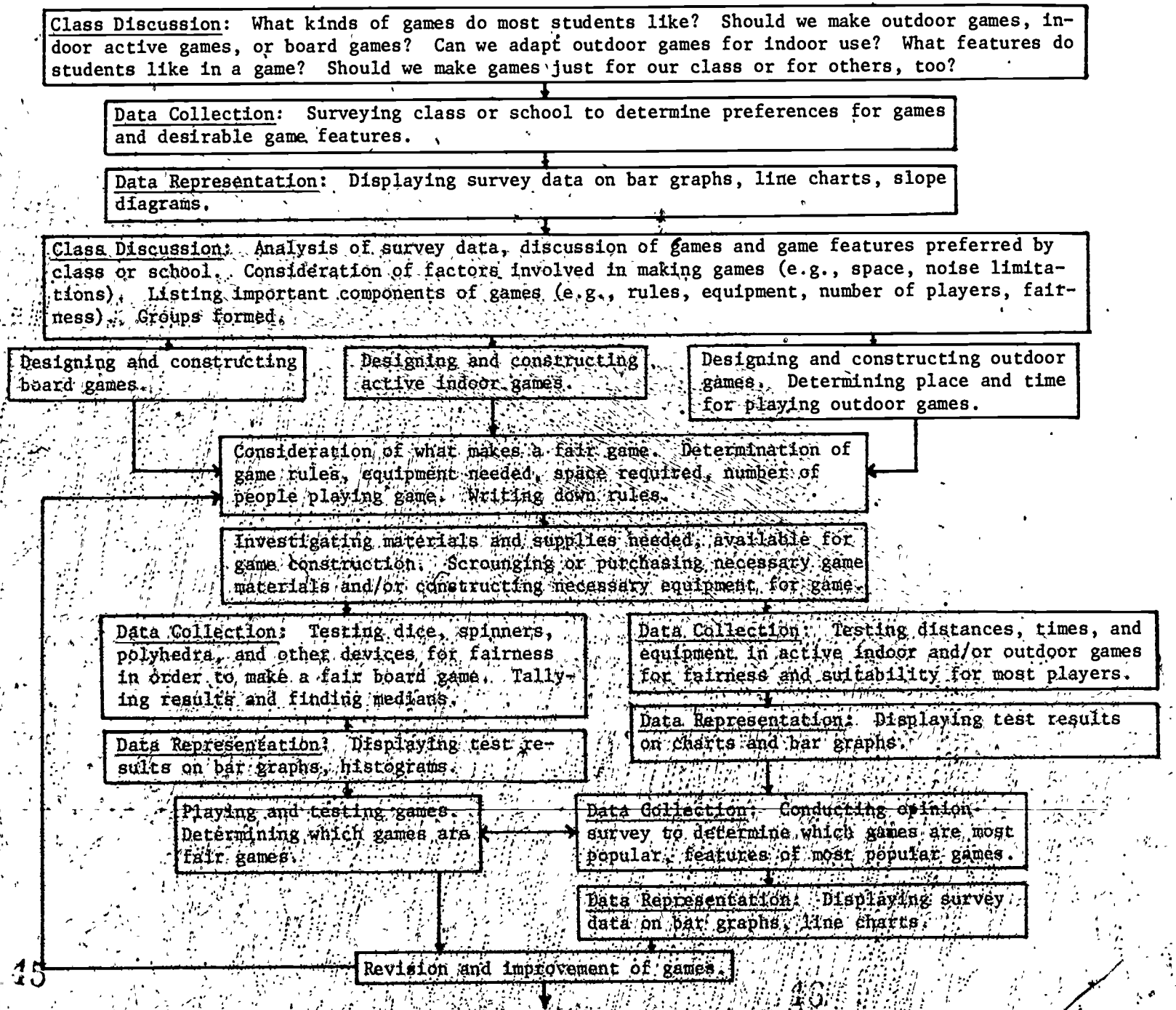
Class Discussion: Groups report on opinion survey, observations, and interviews. Identification of types of activities that most children engage in or would prefer to engage in during available free time.

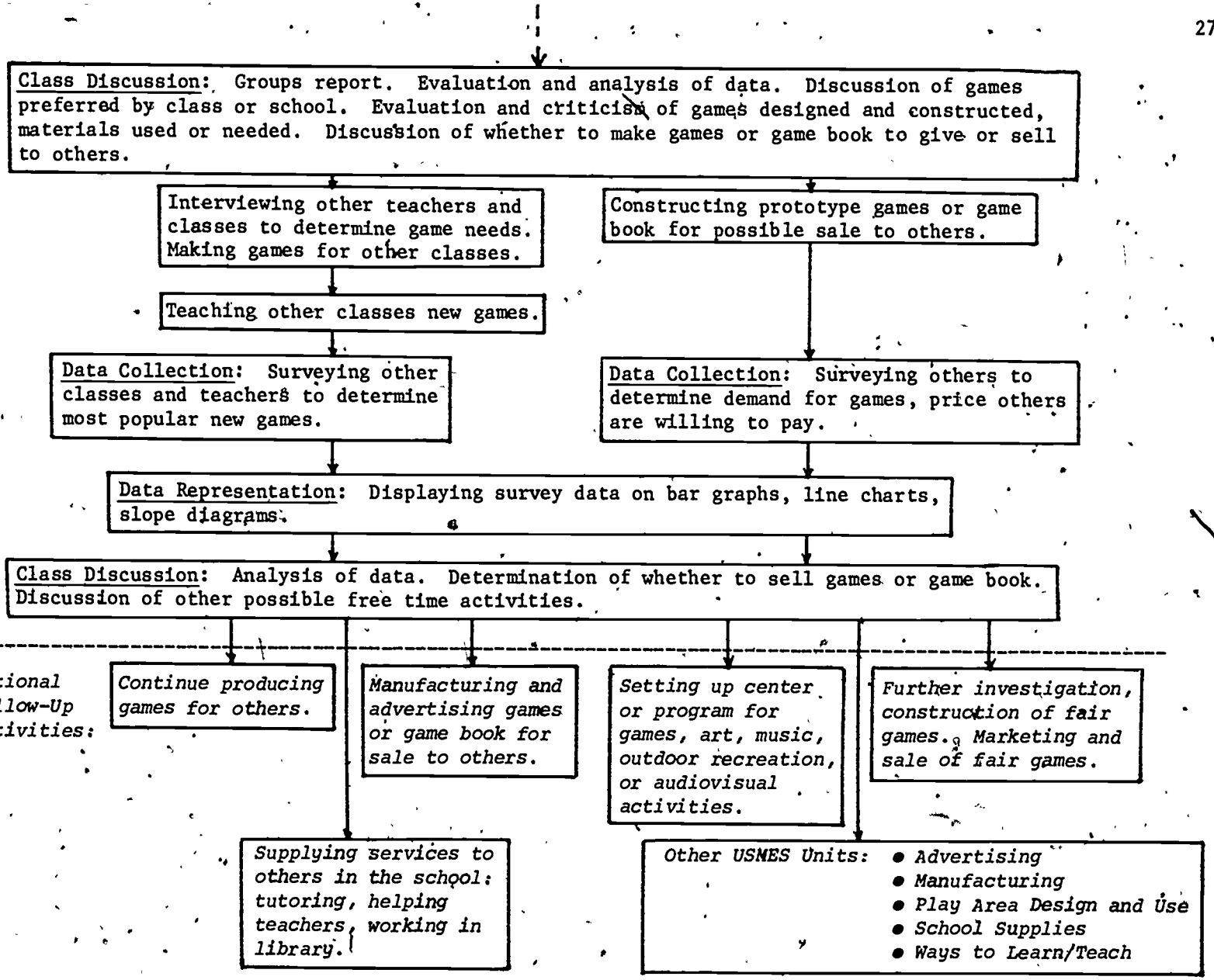
Designing and constructing games for indoor and/or outdoor use. Designing dice, spinners, or other devices for a fair game. See Flow Chart A.

Organizing an art, music, or game center, audio-visual program, or outdoor recreation program. See Flow Chart B.

FLOW CHART A

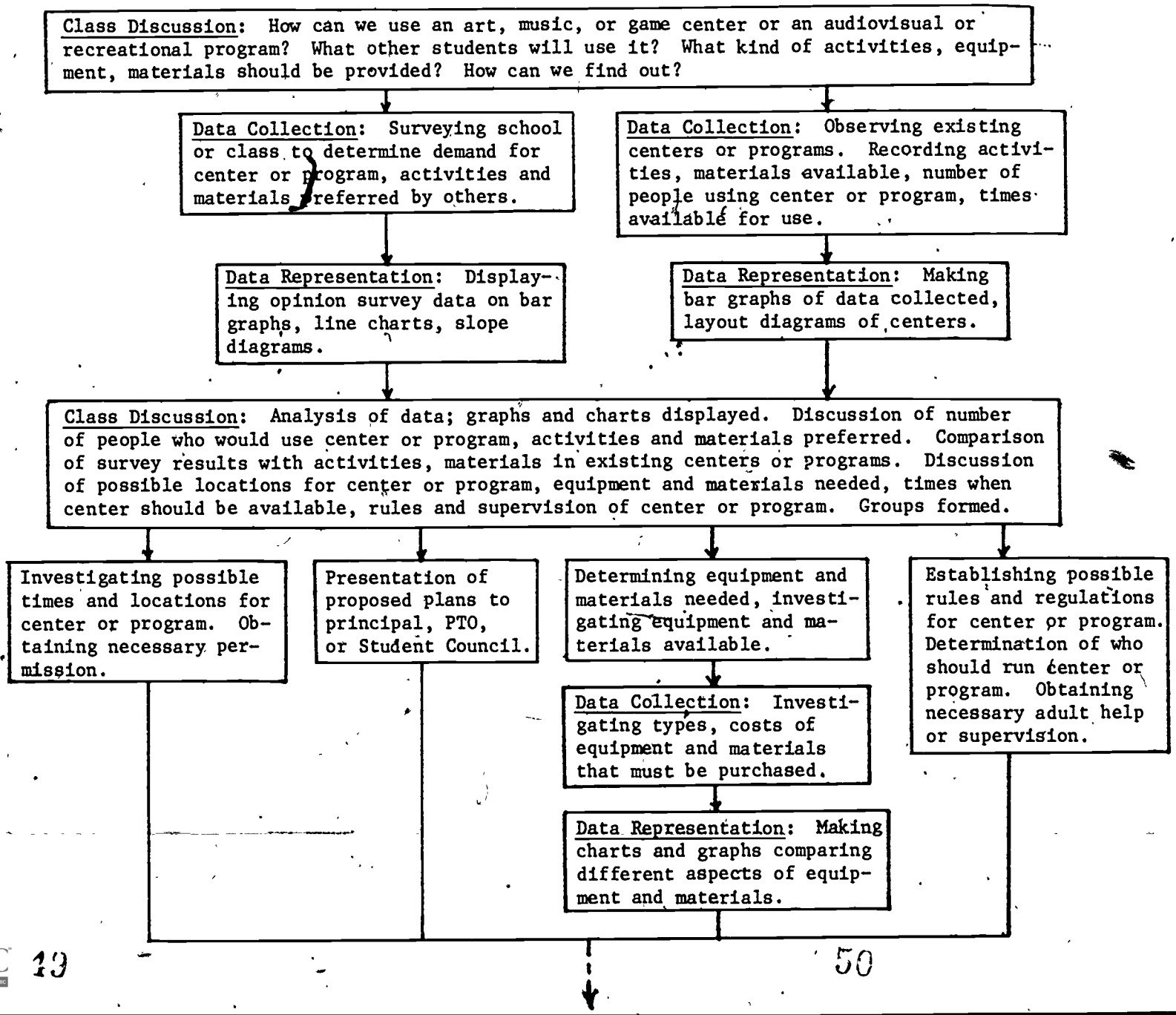
Designing and Constructing Games

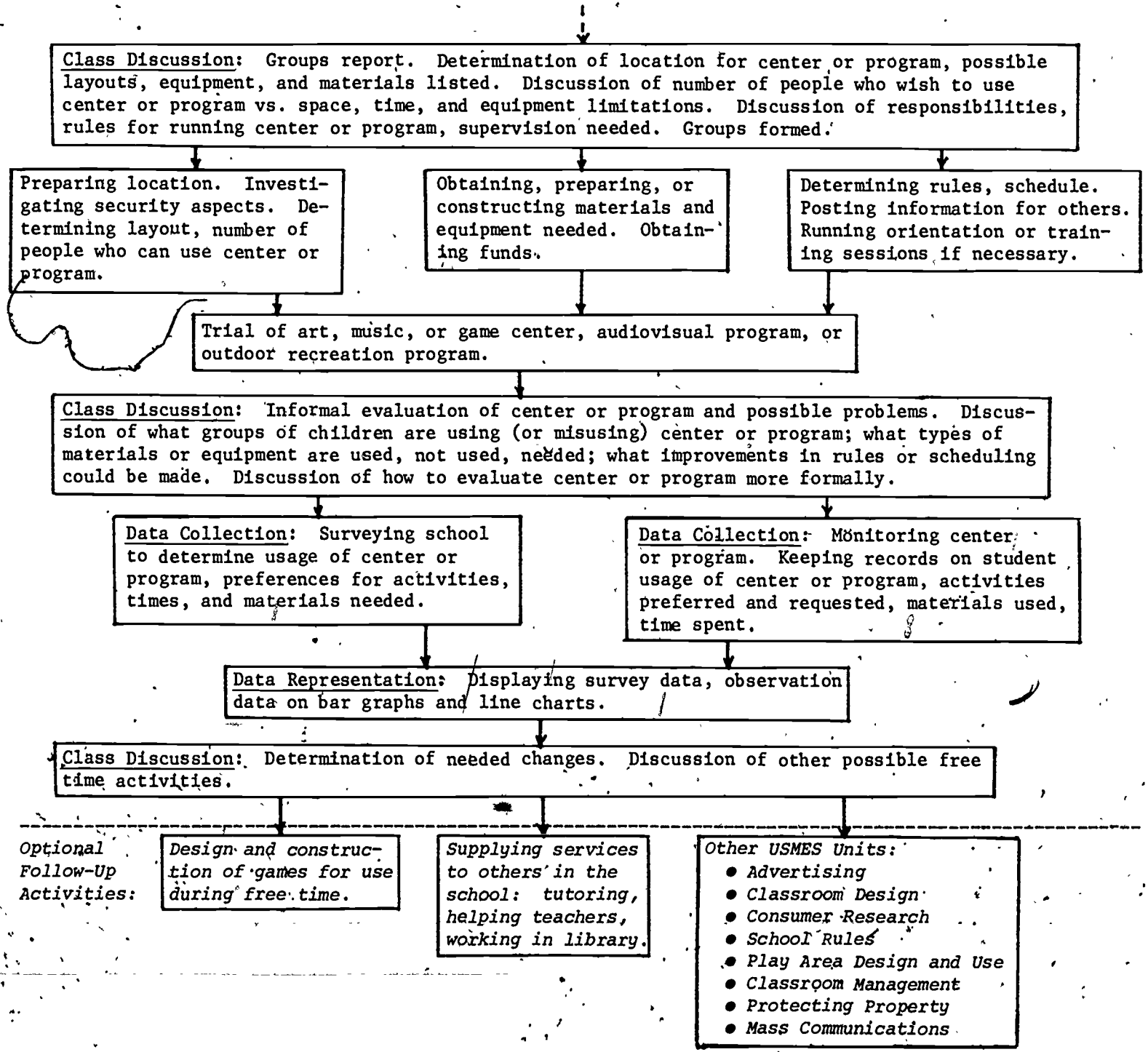



Class Discussion: Groups report. Evaluation and analysis of data. Discussion of games preferred by class or school. Evaluation and criticism of games designed and constructed, materials used or needed. Discussion of whether to make games or game book to give or sell to others.
Interviewing other teachers and classes to determine game needs. Making games for other classes.
Constructing prototype games or game book for possible sale to others.
Teaching other classes new games.
Data Collection: Surveying other classes and teachers to determine most popular new games.
Data Collection: Surveying others to determine demand for games, price others are willing to pay.
Data Representation: Displaying survey data on bar graphs, line charts, slope diagrams.
Class Discussion: Analysis of data. Determination of whether to sell games or game book. Discussion of other possible free time activities.
Optional Follow-Up Activities:
Continue producing games for others.
Manufacturing and advertising games or game book for sale to others.
Setting up center or program for games, art, music, outdoor recreation, or audiovisual activities.
Further investigation, construction of fair games. Marketing and sale of fair games.
Supplying services to others in the school: tutoring, helping teachers, working in library.
Other USMES Units:
• Advertising
• Manufacturing
• Play Area Design and Use
• School Supplies
• Ways to Learn/Teach

FLOW CHART B

Organizing a Center or Program
for Free Time Activities




Class Discussion: Groups report. Determination of location for center or program, possible layouts, equipment, and materials listed. Discussion of number of people who wish to use center or program vs. space, time, and equipment limitations. Discussion of responsibilities, rules for running center or program, supervision needed. Groups formed.
Preparing location. Investigating security aspects. Determining layout, number of people who can use center or program.
Obtaining, preparing, or constructing materials and equipment needed. Obtaining funds.
Determining rules, schedule. Posting information for others. Running orientation or training sessions if necessary.
Trial of art, music, or game center, audiovisual program, or outdoor recreation program.
Class Discussion: Informal evaluation of center or program and possible problems. Discussion of what groups of children are using (or misusing) center or program; what types of materials or equipment are used, not used, needed; what improvements in rules or scheduling could be made. Discussion of how to evaluate center or program more formally.
Data Collection: Surveying school to determine usage of center or program, preferences for activities, times, and materials needed.
Data Collection: Monitoring center or program. Keeping records on student usage of center or program, activities preferred and requested, materials used, time spent.
Data Representation: Displaying survey data, observation data on bar graphs and line charts.
Class Discussion: Determination of needed changes. Discussion of other possible free time activities.
Optional Follow-Up Activities:
Design and construction of games for use during free time.
Supplying services to others in the school: tutoring, helping teachers, working in library.
Other USMES Units:
Advertising
Classroom Design
Consumer Research
School Rules
Play Area Design and Use
Classroom Management
Protecting Property
Mass Communications

5. A COMPOSITE LOG*

This hypothetical account of an intermediate-level class describes many of the activities and discussions mentioned in the flow charts. The composite log shows only one of the many progressions of events that might develop as a class investigates the Using Free Time challenge. Documented events from actual classes are italicized and set apart from the text.

As inclement weather arrives, the children find they are spending more and more recesses indoors. One day, after two weeks of indoor recess, the children begin to complain about how bored they are because there is nothing to do in the room. Several children are reprimanded for throwing paper wads and running around the room. The teacher decides to gather the class together to talk about the problem. The children have many complaints.

"There aren't any fun games to play."

"The classroom games are all missing pieces."

"We can't leave the room to visit friends in other classes."

"We're tired of just sitting around."

The teacher asks the children if they are interested in finding other things to do during recess. The response is a unanimous "yes!"

When a special education class (grades 1-3) in Boulder, Colorado, returned from recess hot, unhappy, and complaining of not enough to do at recess, and of too many people trying to play the same game, the teacher challenged them to find things to do during free time at recess that would be fun. After voting on several possibilities, the class decided to make games to play outside. (From log by Peggy DalPorto.)

One sixth-grade class in Lexington, Massachusetts, was quite upset to learn that the school gym was unavailable during lunch and indoor recess times. After lengthy discussions, the class decided to investigate the total aspect of recess, both indoor and outdoor. (See log by Robert Farias.)

The class is quick to offer possible alternative recess activities. One child records these ideas on the board:

1. Play basketball, volleyball, and other games in the gym.

*Written by USMES staff.

2. Finish incomplete work

3. Read a book

4. Play games

5. Work on crafts, such as make things using clay, string, papier-mache, woodworking, etc.

The class considers each suggestion. Everyone is enthusiastic about using the gym although several children wonder whether other classes would also want to use it. They question how they can possibly arrange the gym schedule so that everyone will have a chance. The class decides to appoint a few children to find out from the gym teacher what the gym schedule is.

The second and third suggestions of finishing incomplete work and reading a book do not receive much enthusiasm. One child remarks that some children already do these, but for most of the class this is not "recess-type" fun!

The class next discusses why the children presently do not enjoy playing the games in the room. Most of the class agree that they are tired of them. Other children complain about missing parts. They agree, however, that they can design and make their own games or make replacement parts.

Many children are enthusiastic about the last suggestion of working on crafts projects. One child mentions several craft items that he made last summer in camp. After several children have described things they have made, one boy breaks in and asks where they can make these things. The class is silent as they look around the room and see that not more than three children can use the one large table in the corner. They realize that if this idea is accepted, they will have to seek another room in which to make their projects.

Following the above discussion, the class agrees that a fair way to choose which free time activity to work for is to vote. A hand vote reveals a tie between games and crafts projects. Because the class is evenly divided between the two, the children agree to work on both. The class divides into two interest groups: a games group and a crafts group.

A fourth-grade class in Austin, Texas, could not decide whether to make card games, other games, or books for use during free time. To solve this prob-

lem, each child rated his/her first, second, and third choices using points from three (first choice) to one (third choice). When the points for each activity were totaled, the children noticed that the totals for games and books were very close and decided to form two groups, one to work on games and one for books. (From log by Laura Rodriguez.)

The children interested in games immediately agree to check first about the use of the gym. They go to the gym and since the gym teacher is busy, are directed to the gym schedule posted on the teacher's office door. The children quickly note that the sixth graders have gym class during the third/fourth-grade recess period. The group returns to the room disappointed.

The group then makes a list of all the games they enjoy playing. After five games are listed, one boy complains that they are all board games. Other boys also voice their complaints, saying they sit all morning and want to move about at recess time. The other group members soon agree. However, as they look around the room, they wonder how they can possibly play a game like baseball or basketball. One girl suggests that they can move all the desks and chairs into the hallway. Someone else vetoes this idea stating they will spend half their recess time moving furniture! One boy suggests simply pushing everything against one wall. The group agrees this is a good solution.

A second list of favorite outdoor games is made. The children feel they can adapt many of the outdoor games for indoor use. Their list appears as follows:

hockey
basketball
football
relay type games
horseshoes

The children agree that some of the listed games cannot be played and decide to adapt one or two games first and then, if these are successful, to adapt others. Before taking a hand vote, the group agrees on several criteria for a good indoor game:

1. can be played within the confines of the classroom
2. can be altered to allow for variation
3. can be played by almost everyone in the room

Several children wonder whether it is fair to vote without the rest of the class. After all, some children in the other half of the class may wish to play games as well as work on crafts projects. The other group members agree to wait until the next class discussion time to vote.

At the next class meeting the games group shows their list of games that can be adapted for indoor use. Four more games are added to the list: baseball, dodge 'em, darts, and Twister. A hand vote is taken; each child is allowed to vote for two games. The class votes appear as follows:

hockey	5	baseball	5
basketball	11	dodge 'em	4
football	3	darts	5
relay type games	10	Twister	9
horseshoes	8		

One fifth-grade class in Athens, Georgia, designed active indoor games to play when the weather prohibited them from going outdoors. A survey was designed to determine the favorite outdoor games. The survey consisted of twenty-three games that the children named. Each child rated each game using points ranging from one ("I hate it. I don't know how to play it.") to five ("I love it."). (See log by Marion Perkins.)

The games group begins with the game of basketball. They agree that they need to find substitutes for the regular ball and basket. Several kinds of soft balls are recommended which include a tennis ball, a ping pong ball, and a styrofoam ball. Most of the boys are against the ping pong balls because they are too small. The styrofoam ball is questioned because no one in the group owns one. One boy asks the group to seriously consider tennis balls because his dad has about twenty old tennis balls he is going to throw out. The group agrees and tells him to bring them all to class. Other group members say they too will bring some in. Without much hesitation, the group agrees to use the two classroom trash cans.

The next thing the group considers is the amount of space available to play once the furniture is moved to one side of the room. Two group members ask the teacher if they may push all the furniture against the wall. The teacher consents, but only during recess time. She asks how much time

it would take to move the desks and how much space would be left for the games. The children explain that this is what they want to determine during the trial run.

The group spends one recess indoors pushing the furniture and timing how long it takes. They learn that it takes almost ten minutes to push the desks and chairs neatly against the wall. They agree that ten minutes is too long. One child suggests clearing only half the room, which would involve pushing half the number of desks and chairs. The group agrees that this idea is more feasible. They quickly return the desks and chairs to their original position and try this second idea. They note that it takes only about five minutes to move the thirteen desks and chairs. Two children measure the available playing room and find that it is nine meters by four meters.

The group then returns to the problem of adapting the basketball game. Several boys point out that there is definitely not enough room to run between the two baskets. This discovery puts the group in a turmoil because no one knows how to adapt the game. After much thought, they finally agree that the game really cannot be played as such.

One girl pulls out the original list of games with the class votes. Suddenly, she suggests combining both the basketball and the relay type games. Why not have teams competing for number of baskets? The group likes this idea and begins figuring out a way to play the game.

The children decide that a good way to determine how to play the game and to determine the rules is to actually play the game. Pushing aside some of the classroom desks, the two wastebaskets are placed 60 cm from one wall. A line is drawn approximately 2 m away from the baskets. Three boys and three girls each toss the tennis balls ten times and make every basket. The line is rubbed off and drawn 50 cm (0.5 m) farther away from the baskets. The children toss again. This time one boy misses one basket. The group decides that the best distance between the baskets and the tossing line is such that the tossers miss half the baskets. The three girls form one team and the three boys form a second one. Two children act as recorders tallying the number of missed baskets. Before they begin they measure the distance between the baskets and the line. Each time the tossers finish, the line is rubbed off and a new one is drawn 50 cm farther back. This procedure continues until the tossers miss most of the baskets. The recorders' tallies appear in Figure B5-1. The group looks at the data and quickly figures the median number of baskets missed for each

distance. They find that the median number missed for 3.5 m is 5 baskets. Everyone agrees that a 3.5 m is a good distance.

	Distance Between Baskets and Line					
	2m	2.5 m	3m	3.5m	4m	4.5m
Tosser	Number of Baskets Missed					
Jenny	0	0	2	6	9	10
Mary	0	0	3	5	8	10
Susan	0	0	2	7	10	10
Mark	0	1	2	4	6	9
Peter	0	0	1	5	5	9
John	0	0	2	2	4	8

Figure B5-1

Further game revisions are made after one boy comments that it really is not very exciting just to toss balls. One girl suggests timing the number of baskets each team can make within a certain number of minutes. Another girl comments that it takes her a long time to retrieve the ten balls after Jenny throws them. The group decides that the tosser must collect his/her own balls and return them to the next tosser. Other students say that tennis balls bounce too much and that styrofoam balls should be used. The children agree to scrounge for styrofoam balls and a stopwatch.

The next day, the same two experimental teams play the game with the recorders agreeing on a time length of one minute. The contest begins as soon as one recorder says, "Go." A third child watches the stopwatch. Suddenly, someone says that Mary stepped over the line. The contest is stopped and a big argument ensues. After much heated debate, the children agree that the timer should also watch the line to make sure no one steps on it. There are strong feelings among the group members that if someone actually does step on the line, the team, not the individual should take a penalty. The children decide a fair penalty is subtracting five baskets from the team's total score.

Rules for Relay Basketball

1. Distance between baskets and tossing line is 3.5 meters.
2. Each tosser gets ten tosses.
3. Each tosser collects all ten balls after throwing and gives them to the next tosser.
4. Keep feet behind the line.
5. If feet touch or go over the line, that team loses five baskets from their total score.
6. When the timer says "stop," everyone must stop. If someone has just tossed the ball, the basket does not count.
7. If someone starts before the timer says "go", that team loses five baskets from their total score.

Figure B5-2

The game is played several times before they must stop for the day. Two students agree to write down the game rules, which are shown in Figure B5-2.

During the next recess time, the whole class plays relay basketball. Teams are picked by drawing names from a hat. Two recorders are picked as well as a timer. The children greatly enjoy the game and are disappointed when time runs out.

The fifth graders in Athens adapted the game of baseball for indoor use. Rather than using a ball and bat, a balloon and one's head were used. After the game was played several times, however, several classmates complained that it was difficult to hit the balloon with one's head. The game rule was modified so that the players could use their hands. (See log by Marion Perkins.)

A third-grade class in Lansing, Michigan, developed several active games for indoor use, among them a bean bag toss called "500" and a game called "Treasure Hunt." After all the children in the class had played the games, the rules were revised, and the games were tested again. (See log by Sandy Szedlak.)

During the next few weeks, the games group thinks of ways to vary the relay basketball game. Each time a variation is devised, the group tests the idea. If they enjoy it, the idea is included on the list. After two weeks their list appears as in Figure B5-3.

The fourteen children who are interested in crafts begin by discussing where to find enough room to work. One child suggests the storeroom on the first floor. The teachers' seminar room, the music room, and the Design Lab are also suggested. When they have exhausted all the possibilities, they consider the advantages and disadvantages of each locality. The storeroom is eliminated because one child remembers it to be "full to the brim." Where would all that stuff be put? Many are against the music room because of all the valuable equipment it contains. Children would have to be very careful and that is not the purpose of the crafts room. In the end, the group agrees that the seminar room and the Design Lab are the two best candidates.

Ways to Change Relay Basketball

1. Change the amount of time.
2. Change the openings of the baskets (tape paper over the tops).
3. Change the heights of the baskets.
4. Use different sizes of containers. Each container is worth a different number of points.
5. Toss five balls with your right hand and five with your left hand.
6. Stretch a string across the front of the baskets. (Tie to two chairs.) Vary the string heights. Balls must go over or under the string before landing in the baskets.

Figure B5-3

A sixth-grade class in Boulder, Colorado, set up a music center in a seminar room after first investigating the possible use of the school library. Although the seminar room was available for only two hours, three days a week, it was favored over the library because there were no stipulations. If the center had been located in the library, the children would have had to follow the library rules. (See log by Elizabeth Gilpatrick.)

Two group members are picked to seek permission from the principal to use either the seminar room or the Design Lab. They write up an outline (shown in Figure B5-4) of what they are going to say to him.

Before they go, however, they agree that they should look at each room. Looking first at the seminar room, they quickly agree that it is "perfect," with three large tables, lots of bookshelves, and a very comfortable carpet on the floor. Two children wonder whether it is too nice. Next, they go downstairs to look at the Design Lab. As the manager is there, they explain their proposed plans. The manager feels their plans are good and points out possible work areas. The children become quite excited when they see two large work tables and a long counter in one corner of the lab. They immediately agree that the Design Lab seems more practical and feasible than the seminar room. However, they decide to ask the principal about both rooms.

The following week the two children report to the group that the principal is agreeable to their proposed crafts center. However, because it is the only room available for guests, emergency meetings, etc., he prefers that they not use the seminar room. Besides wondering whether children in other classes should be allowed to use the room and materials because they, too, have a similar recess problem, he reminds the children that they need to arrange for adult supervision.

The children consider the possibility of allowing other classes to use the center. One child points out that the available lab space can accommodate only so many children. No one knows the total number of students in the school, but all know the number of third/fourth-grade classes in the school. Getting paper and pencil, two children calculate an estimate of the number of third- and fourth-grade children in the school. Estimating that there are about 28 students in each of the four classes, the children total up four twenty-eights and decide that there are about 112 third-

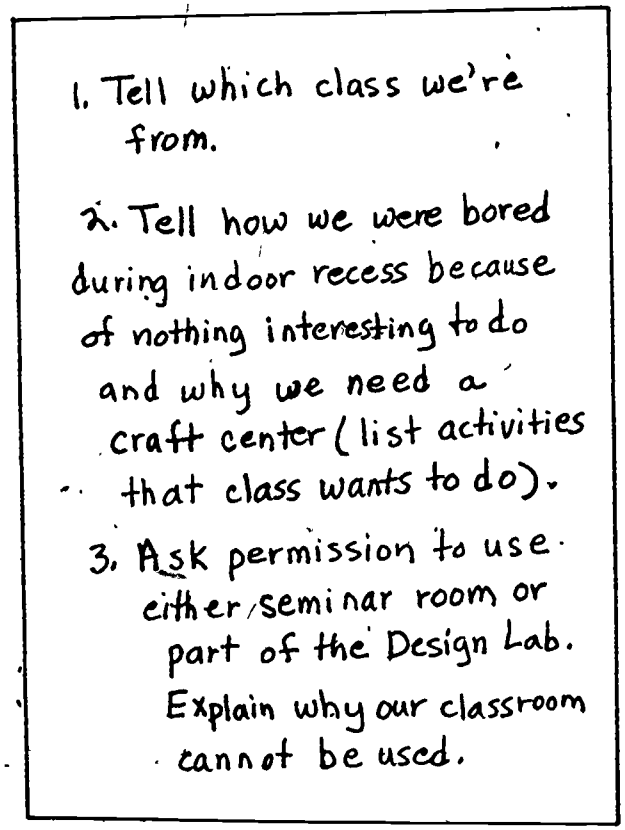


Figure B5-4

and fourth-grade students. Seeing this, the group definitely rules out allowing the entire school to use the center. Even with the four third- and fourth-grade classes the group wonders how they can possibly accommodate this many in the center each day.

The children then consider dropping two classes, allowing only one other third- or fourth-grade class to share the center. However, they soon realize they will get into a lot of trouble with friends in the two classes that are left out. They also consider allowing just their class to use the center. One boy reminds the group that in their room alone only fourteen of them are interested in the center. It is agreed, then, that more than likely, this situation will be similar in the other classes. In addition, one girl points out that not everyone has to work in the center at the same time. A schedule can be made and the various classes may be assigned a day. The group likes the schedule idea and is quite relieved that the problem is resolved.

The Boulder class decided to pick children at random from the various grade levels to use the music center. The children found out from the school office the proportions of boys to girls and of upper to lower elementary children in the school. This was done to insure a representative sample of the whole school. As it turned out, the ratio of boys to girls was almost one to one. Therefore, the group agreed that one boy and one girl from each class would be a representative sample. The sample group was picked by randomly pointing a finger to a name on a class list. (See log by Elizabeth Gilpatrick.)

The next time the center group meets, a quick review is made of what has been done. Having obtained permission for use of the Design Lab, the children decide they have two main tasks to do in order to set up the center. They decide to divide into two groups. A brief outline is made of what each group is to do:

1. One group needs to find out what supplies are already in the lab that may be used in the center. The group will need to ask the

manager because only he knows what the lab demands are for various materials. Then a list should be drawn up.

2. The other group needs to find out what other children want in the center, for example, what kind of projects they want to work on or materials they want to work with. An opinion survey should be made and handed out to the other three classes as well as their own.

Before disbanding, the children agree to meet as a total group at the end of each day in order to assess progress.

The survey group discusses how to design the opinion survey. One girl recommends that the first question on the survey should be "Do you want to use the crafts center?" If children do not want to use the center, they do not need to fill out the rest of the survey. The group agrees this is a good idea. They proceed to list various survey designs:

1. Have each person answering the survey write down all the things he/she would like to make.

2. Have each person answering the survey write down the one or two projects he/she would like to do.

3. Have each person answering the survey check which projects or materials he/she would like to work with.

Each design suggestion is thoroughly discussed. With the first two designs the children are worried about the possibilities of children listing projects for which they will not be able to provide materials. The last design is accepted, but the group members are divided on whether projects or materials should be listed. The children favoring projects reason that if children see the projects listed, they can pick the one they need or want for a particular reason. In other words, the projects dictate what materials to keep on hand in the center. They point out that with only a list of materials, children may check off certain materials and then not know what to make. The children

Crafts Center Survey

We are planning a crafts center. It will be in the Design Lab. You may use the center during recess time. Please answer our questions below.

1. Do you want to use the center?
   ☐ yes ☐ no

2. Please check one project you would like to make in the center.
   - paint, color ☐
   - clay animals ☐
   - papier-mâché animals or puppets ☐
   - string or thread pictures ☐
   - metal designs (pie tins) ☐
   - woodworking (Tri-Wall, too) ☐
   - sew things ☐
   - other: _____ (please list materials you will need.)

Thank you

Figure B5-5

who favor listing materials argue that they cannot possibly think of all the kinds of possible projects others will want to make. "What if a child wants to make something not on the list?" one member asks.

After considerable debate, the group finally agrees to list projects but to leave one space for those who want to make a project not on the list. These children will be required to write a brief list of materials required. If the list is reasonable, the materials will be obtained.

In writing the survey, the group uses some of the projects mentioned in the initial class discussion. They spend a week planning and writing. Two children make appointments with the other three classes. The final survey is put on a ditto master (see Figure B5-5) and run off by the school secretary.

During the following week the group administers the survey in pairs. The children carefully explain to those who are not interested in the center that they do not have to complete the second survey part. The survey is also administered to their own group members.

When all the surveys have been completed, the group sorts the surveys from each class into two piles, those who are not interested in the center and those who are. One child tallies the number in each pile on paper. The results are shown in Figure B5-6.

The children next tally the projects and obtain totals as shown in Figure B5-7. The group is surprised and a little relieved that no one bothered to add his own project. Because a class discussion is scheduled for the following day, the group decides to make bar graphs of the data as they have done in the past. One bar graph of the data is shown in Figure B5-8.

> *In order to determine what music to offer in the music center, the Boulder class asked each class to suggest songs or records they liked. A suggestion box was prepared for each grade level. When all the suggestions had been collected, the class categorized the music as best as they could and tallied the frequencies with which various titles occurred. Music was then selected based on the survey results. (See log by Elizabeth Gilpatrick.)*

As the survey group works on the survey, the inventory group goes to the Design Lab to assess the materials avail-

Class	Number of children who want to use the center	Number of children who do not want to use the center
Miss A.	14	14
Mr. B.	13	15
Mr. S.	10	18
Mrs. T.	13	15

Figure B5-6

Project	Number of children who want to make the project
paint, color	9
clay animals	7
papier-mâché animals or puppets	7
string or thread pictures	1
metal designs (pie tins)	1
woodworking (Tri-Wall, too)	17
sew things	8
other	0

Figure B5-7

able for the center. Because they do not know what projects children want to make and, therefore, specifically what materials are needed, the group decides to make a general list of materials that can be requested. They also decide not to list the Design Lab tools and "standard" materials, such as nails, screws, Tri-Wall, wood, glue, paper, and tape. It takes the group three days to make a list. Their final list appears in Figure B5-9.

When the inventory has been completed and the survey data tallied, the crafts group makes the following list of materials that are needed in order to work on the requested projects:

Materials needed for requested projects

paints	Tri-Wall
crayons	fabric
clay	thread
newspapers	sewing needles
paste	pie tins
wood	string

The children decide they can then compare the inventory with the materials needed and decide what they need to buy or scrounge.

In comparing the two lists, the children note they need to scrounge or buy the following materials:

crayons
newspapers
fabric
sewing needles
pie tins

The children agree that crayons, newspapers, and sewing needles can be easily obtained from home or at school. One girl remembers that her neighbor sews and, therefore, can probably provide plenty of fabric scraps. Because only one child requested metal design, the group agrees that one of their mothers will have enough pie tins to satisfy the demand.

This situation reminds the group that they had better check the quantities of some of the materials. Because the inventory group forgot to do this, the whole group returns to the lab to compare available quantities of various materials with number of requests. Immediately, they note

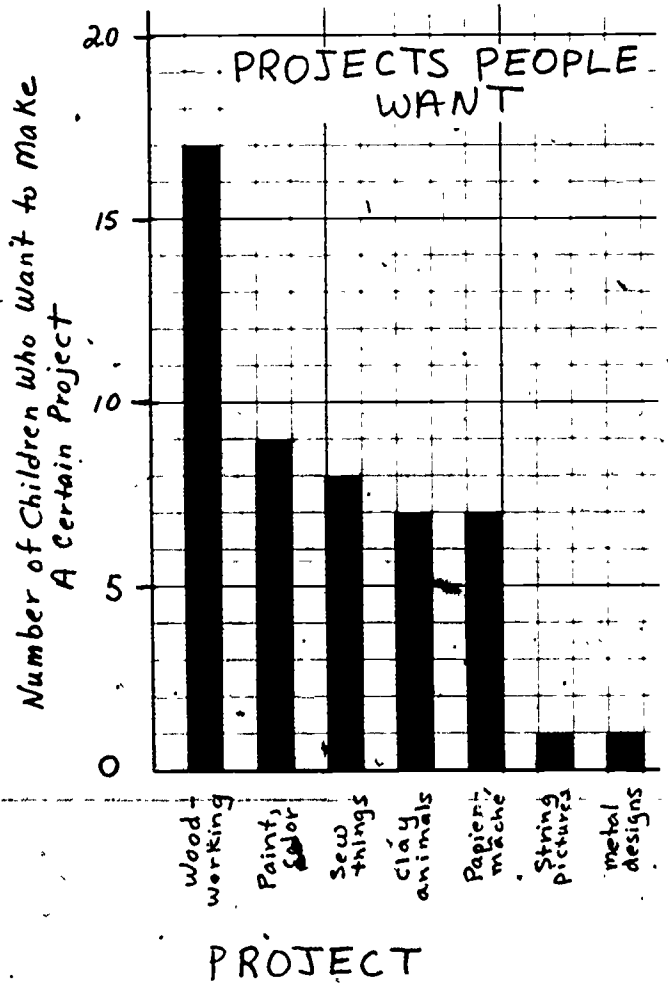


Figure B5-8

that there is not enough paint, in quantity as well as in variety, for nine painters. Paint is then added to the scrounge list. The group agrees that there is enough clay and string. The number of lumber/Tri-Wall requests is shown to the lab manager who suggests that they bring in any scraps they may have at home.

At the next class discussion the crafts group reads the list of materials presently in the lab and the list of needed materials. As the lists are being read, the games group members perk up. Several children comment that if the crafts group needs to scrounge for more paint, then they certainly will also because several children are planning to paint their games. The class realizes that although the two activities are somewhat different, both will require building materials.

The class discusses at length ways to go about scrounging for materials after they realize how time-consuming it will be to try and raise money from bake sales. Some of the children's ideas include--

1. ask the art teacher for surplus paints, paper, etc.
2. write letters to parents
3. hang posters around the school
4. pass flyers around the neighborhood

One child suggests calling the high school art department because her sister told her how much they always throw out after each art class. Everyone agrees that all the ideas are good. The class decides that once the crafts center is set up and running, a group can be formed to attack the scrounging problem systematically. Meanwhile, the children agree that they themselves can scrounge enough materials to get started.

The group making books in the Austin, Texas, class found they could scrounge all needed materials for their books except paper (a large quantity was needed). They used the telephone directory to locate paper stores and called each store to determine the price. After they had determined which store was least expensive, several members of the group went on an after-school field trip to the store to purchase the paper. (From log by Laura Rodriguez.)

Materials Available for Crafts Work

box of scrap wood and Tri-Wall
wooden rods (3 different sizes around)
wire (3 different thicknesses)
paper cups
straws
marbles
paper clips
string (2 different kinds)
thread (red, black, white, green)
felt-tipped pens (red, black)
clay
paint

Figure B5-9

The crafts group next works on a schedule for the center. At first they decide that each class will be assigned one day. However, one child reminds the group that only so many can work comfortably in that particular area of the lab. Another visit to the lab is made. The fourteen group members pretend they are working on projects in order to assess the amount of work space needed and find that fourteen children in the area are too many. Two, then three, then four children step aside. The ten remaining children agree that they now have enough working space.

The group realizes that in order for everyone to work in comfort, ten children is the maximum number of workers for the available room. Someone suggests expanding the center, but this idea is quickly vetoed because the lab manager has told them that other classes need to use the room too. Finally, it is agreed that the excess children will have to be scheduled for the fifth day. One child comments on how lucky they are to have one extra day!

The children do not know how to schedule the extra children because they do not know the names. They also realize that the scheduling can be tricky because most children will want to go on the same day their friends are going. After much thought, the group decides to leave this problem for each class to solve. They agree to make a sign-up sheet, leaving only ten lines per day for each class. Their sign-up schedule appears below.

Sign Up Sheet For Crafts Center

	Mon.	Tues.	Wed.	Thurs.	Fri.
Miss A.	1. 2. 3. 4. 5. 6. 7. 8. 9. 10.		1. 2. 3. 4.		
Mr. B.		1. 2. 3. 4. 5. 6. 7. 8. 9. 10.	5. 6. 7.		
Mr. S.				1. 2. 3. 4. 5. 6. 7. 8. 9. 10.	
Mrs. T.			8. 9. 10.		1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

Because there were only seven earphones, the sixth graders in Boulder decided to allow only seven children at a time to use the center. Also, as children left their respective classrooms, they had to sign out (both name and time of their departure) and had to have their teacher's consent. The children felt that if someone abused the equipment, they could refer to the individual class charts to discover who it was. (See log by Elizabeth Gilpatrick.)

When the crafts group waits for the sign-up sheet to return, attention is focused on supervision. The third- and fourth-grade teachers are ruled out because they will need to supervise half of the class when the other half goes to the center. Teacher aides are considered a possibility because they supervise the various grades during lunch time. The children decide to inquire whether one or two aides can come in a little earlier. The Design Lab manager is another possibility. No one is sure what he does when the third and fourth graders are at recess. They decide to check with him. One boy wonders whether someone's parent would be interested. He reminds the group of Mr. P. who volunteered some time in the lab last year. The children agree that this, too, is a good possibility. One girl suggests a high school student. She notes that Miss W. has one in her class in the mornings.

When the children cannot think of any other people, they assign two members the task of checking with the lab manager. Three children volunteer to speak to the principal regarding the teacher aides and the high school students.

The following day the crafts group learns that the principal is checking on the high school students. The two aides that come to school early are needed in the office. The other two aides have small children and cannot come earlier. The other small groups report that the Design Lab manager uses Tuesday and Thursday mornings to plan and buy supplies. However, he is free and willing to supervise on Mondays, Wednesdays, and Fridays. Later that afternoon they learn that Miss W.'s high school student can supervise on Tuesdays. The children decide to revise the schedule by eliminating Thursdays and allowing each class ten spots on one of the days.

The sixth-grade class in Lexington arranged for adult supervision for winter sports by circulating

a memo among the faculty asking for volunteers. In the spring the children asked the faculty to participate in softball games. (See log by Robert Farias.)

Finally, the group establishes the following rules for the center:

1. No more than ten people in the center at one time.
2. No one can work in the center without adult supervision.
3. No wasting materials.
4. Allow enough time to clean up your mess.
5. Always clean up.
6. Anyone who breaks the rules twice cannot use the center until permission is granted by teacher.

In addition to scheduling monitors in the music center, the sixth graders in Boulder decided to show the children who would be using the center how to use the sound equipment. This plan was agreed upon because the children readily admitted that they usually did not bother to read instructions and rules. The class decided to orient all users to the music available, to the center's schedule, and to the rules. (See log by Elizabeth Gilpatrick.)

After the Lansing class had developed a number of games for other classes in their school, they decided that they should schedule a time to teach the games to the other classes. To do this, they set up the following guidelines:

- *About a week before the teaching day each group will set up a convenient time to teach with the teacher.*
- *The groups will ask the teachers for a one-hour session to teach the games.*

Crafts Center Survey

Name _____

Class _____

Do you like using the center? _____

What do you not like about the center? _____

_____

materials?
schedule?
amount of time in the center?

Figure B5-10

Do you like using the center?

0 No 50 Yes

What do you not like about the center?

Not enough materials 19

Not enough time 31

Figure B5-11

- *The day before the teaching day, each group will give the teacher directions on how his/her class should be arranged.*
- *Each group will take their games to the assigned class when they go to teach, not before.*
- *The games will be left in the classroom for three days in the kindergarten and two days in grades one through six.*

(From log by Sandy Szedlak.)

When the sign-up sheet is returned, the group sets about writing notes to the other three classes announcing the opening day. A final check of the materials is made.

On opening day, the whole class goes down to inspect and marvel. Because the day belongs to their class, the whole recess time is spent with the center group showing their classmates all the materials that have been brought in. Many children in the games group now express a desire to work in the center. The teacher assures them that the activities will alternate because there will be plenty of bad weather days coming.

After the center has been in operation for three weeks, the crafts group decides to survey users for satisfaction. A few complaints have been received during the three weeks, and so the group designs a brief survey (shown in Figure B5-10) to determine what the complaints are and how many there are.

The survey is given to each class as it uses the center. By the end of the week all the surveys are completed. The group tallies the results. (See Figure B5-11.).

The children are very surprised that so many children complained about the lack of materials. During the three weeks the group had continually brought in materials and even obtained the help of another third/fourth-grade class. The group realizes that they really need to organize their efforts better, using the various ideas that they had thought of earlier. Eight children express an interest in "campaigning" for materials.

The group wonders what it can do about the second complaint of not enough time. Some group members feel that a lot of children always feel recess time is too short. However, one girl points out that this can be a real problem

if someone is making something out of wood. It takes about ten minutes to get all the necessary tools and supplies and to set up. The group discusses how the recess time can be expanded but agrees that this is impossible. The only feasible idea they think of is to investigate the possibility of having the center remain open during lunchtime. They agree that the main problem would be supervision. Three children volunteer to check with the principal.

After two months some children who are finished in the crafts center now want to design active games. Others want to continue their campaign to scrounge materials for the crafts center. Some games group members want to use the crafts center. Because many children want to play or do something else during the recess time, the class decides to regroup. They agree that recess time has greatly improved. However, there is a general consensus that the classroom is too cramped to work in. The complaints are generally about the desk rows and how they impede any kind of group work. The class agrees to work on the Classroom Design challenge next.

After spending considerable time making board games to be played during indoor recess, a Watertown, Massachusetts, class became interested in helping younger children learn and in helping the art teacher and librarian clean. (See log by Marie Salah.)

After spending considerable time on making board games, part of one sixth-grade class in Washington, D.C., became interested in other free time activities. Their activities were more individualized and consisted of sewing, crocheting, and tutoring younger children. (From log by Jeanette Lea.)

6. QUESTIONS TO STIMULATE FURTHER INVESTIGATION AND ANALYSIS

A. General Questions

- What do you do when you have finished your lunch or have some free time?
- How can free time activities be improved so that they would be more useful, fun, or educational?

- When do you and other students have free times during the school day?

- What do you and other students want to do during free time (e.g., indoor recess, lunchtime)? How can we find out? How many people should we ask? How do we pick our sample?

- What should we do with our survey data? What does the data tell us? What kinds of graphs and charts could we make?

B. Games

- What makes a game fun and interesting? How can we find out?

- What is the smallest and largest number of people who can play your game? How can we make a game everyone can play?

- How much space does your game require? What equipment do you need for your game?

- What age group can play the game?

- How can you make the game more durable?

- What are the game rules? How can you determine whether the game rules are clear?

- How do you know if your game is fair? How can you show that your game is fair?

- How popular is your game? How can you determine whether your game is fun to play?

C. Art, Music, or Audiovisual Center

- How can we set up an art, music, or audiovisual center in our school? Where will the center be located?

- How many children are interested in using the center? Who should be allowed to use the center? How can you find out?

- What kinds of materials (e.g., art supplies, records, tapes, filmstrips) should be in the center? How can you find out what kinds of materials others wish to use in the center? How can you get these materials?

- How long and how frequently should the center be open? What sort of schedule is needed?

- What kinds of rules do we need for the center? What happens to violators?

- How can we provide adequate supervision? How can we protect the equipment and materials? How will we monitor and replenish supplies?

D. Indoor/Outdoor Recess Program

- How can we set up an indoor/outdoor recess program? What kinds of activities should be offered? How can we find out?

- Who is interested in an indoor/outdoor recess program? Who should be included in the program?

- Where can we get the necessary sports equipment?

- How can we provide adequate supervision? What kinds of rules are needed? What happens to violators?

E. Evaluating Activities

- How can we evaluate the success of our free time activities (games, center, recess program)?

- What changes have taken place in the school since the games were made....center was opened...indoor/outdoor program was set up?

- What revisions need to be made to our games.... center....recess program?

C. Documentation

1. LOG ON USING FREE TIME

by Sandy Szedlak*
Allen Street School, Grade 3
Lansing, Michigan
(September 1974-April 1975)

ABSTRACT

This third-grade class began work on game design after being challenged to design games for four or more people to play. The children first designed outdoor games with each student evaluating the games after they had been played. As a result of the evaluation, a more general opinion survey on games was developed and conducted in the class. The results of this survey were then used as a starting point for designing additional games, both board games and active games. After spending several weeks on the design, construction, and revision of their games, the children tried out their games with a second-grade class and surveyed other classes in the school on their game preferences. Using the responses of the trial class and the results of the school-wide survey, the children spent over a month designing and constructing games for each class that was surveyed. After the games had been used by the other classes for several days and after an opinion survey had been conducted to determine which games were most popular, the class worked together to compile a game book (containing over fifty games) which was sold to other students and teachers. With their work on games completed, the children developed lists of other free-time activities and began work on an activity of their choice.

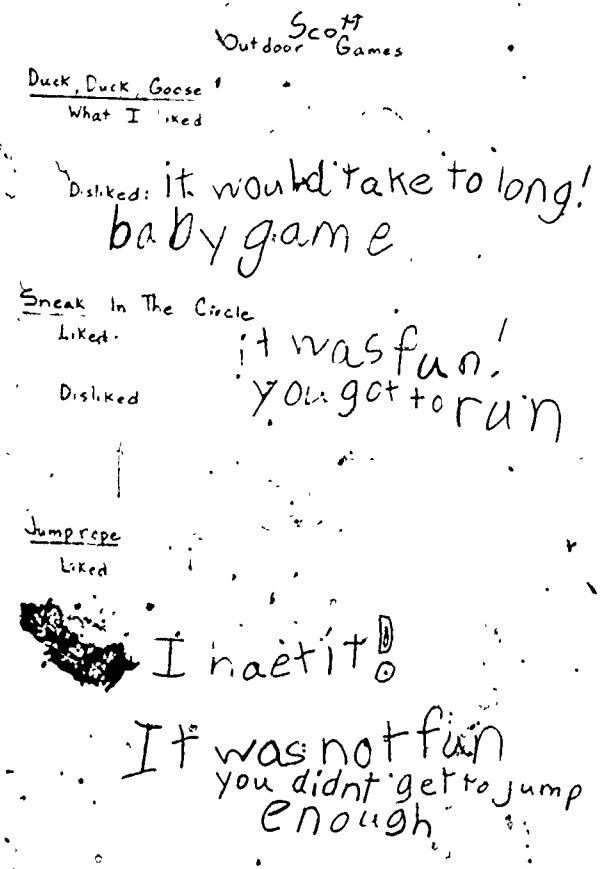


Figure C1-1

After a discussion that I initiated about games they had played outside, I challenged my class to design games for four or more people to play.** During this initial discussion, the children first listed different kinds of games and

*Edited by USMES staff

**In the middle of the year the focus of the unit being developed was broadened from game design to ways of Using Free Time with game design as one aspect. A game design challenge often comes up naturally in a discussion of how to use free time.--ED.

QUESTIONS

1. What game do you like best?
2. What do you like about it?
3. Do you like to kick the ball?
4. What kind of equipment do you need?
5. Do you like a team game?
6. Do you like relay races?
7. Do you like games with 4 people?
8. Do you like games where someone is "it"?
9. Do you like a board game?
10. Do you like 2 people games?
11. Do you like running games?

Figure C1-2

where they could be played. The games were grouped into categories of outside games, board games, and active games that could be played either inside or outside.

When I asked the class what information they would need to play a game that they had never played before, the students made the following suggestions:

- we would need to know the rules
- what equipment to use
- the number of people
- where to play the game

The class then divided into six groups of four students each to design games for four or more people to play.

Because most of the games they developed were outdoor games, the class met outside to try out each game. Each group in turn explained their game, and the whole class then played each game. Several of the games were taking too long, and so the rules were modified to shorten these games. After four games had been played, it was time to end the class.

The next day, the last two groups explained their games, using the board to illustrate the layouts. Each student evaluated the games on a piece of paper, telling whether he/she liked or disliked a game and why. (See Figure C1-1.)

At the next session, I read the children a combined list of their responses to each outdoor game. I then asked the class how we could find out what kind of games (both outdoor and indoor) most people would like to play. Together we developed an opinion survey which I recorded on the board and later reproduced as shown in Figure C1-2. After passing out paper, the whole class went through the questions and marked their responses on the paper.

When the class met again, I gave them the list of survey questions and a graphing sheet. After explaining that I had added up all their responses from the day before, I asked them to look at the graph paper and figure out how they could show the survey results. Two ways were suggested:

- Put checks in the boxes all the way up to the number of people.
- Just put a check in the highest box.

After the results of each question were listed on the board, the children proceeded to fill in their graphs (see Figure C1-3 for a sample), using either of the suggested ways.

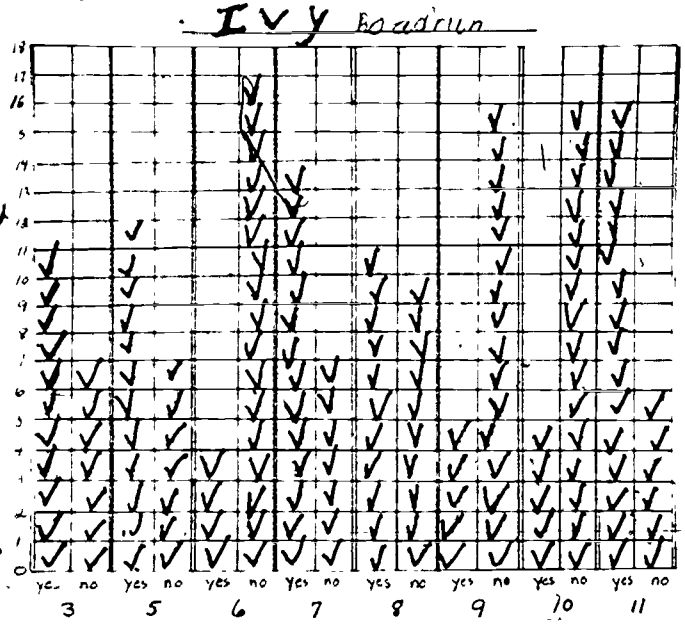


Figure C1-3

Using the data from the graphs, we compiled two lists--one of likes and one of dislikes--about the games on the board. (These lists are shown in Figure C1-4.) When one of the children questioned the large negative response to relay races, the class decided to vote on this question. Most children then voted that they liked relay races, which contradicted the earlier response on the survey. We corrected our lists and graphs to reflect this.*

I then asked the class whether they would like to make up some games that would reflect the positive suggestions from the survey. The class divided into groups to work on games of their choice. Three groups planned to work on some sort of board games and four other groups decided to work on either outdoor or active indoor games. Each new game was to include things that people like in a game.

During the next few sessions the groups made preliminary plans, developed their games, and then began to construct preliminary models of their games, including game boards, dice, and markers. Several students made dice from cubes and tetrahedra. Students who had completed their models went to the Design Lab to make final versions of their games.

Some of the games they developed are described below.

The Trip Through the Forest: A board game for two to six people with squares in a path. Markers are "Funny men." A die is thrown and markers are moved the number of squares shown on the die.

Doll House: Rules are not yet developed but the idea is that the children should crawl through a large doll house (as they play the game) which the group is constructing.

Monster: A board game with squares arranged in a zig-zag shape. Each square has a different number (one of 1, 2, 3, 4, 5, 6). When the die is rolled, the monster moves to the corresponding number on the board. The object is to finish first.

500: This is a bean bag toss into a brightly painted box. Each person has four turns and each toss into the box is worth five points.

Figure C1-4

When all the groups had finished their games, the children rotated to different groups to try out one another's

*The class might discuss whether the responses to other questions might also be wrong.--ED.

"500"

You take a beanbags. You try to make a basket. If one goes in, you get 5 pts. If you get both, you get 25 points.

You have one pick-er-upper who stands by the box and collects the beanbags. He brings the beanbags to the next person.

The line you stand behind is ten feet from the box. The person with the most points wins.

5 players
1 pick-er-upper

Figure C1-5

games. It became apparent that several games needed to have their rules revised or developed in more detail. At the next session, each group wrote out the much-revised rules of their game. (Figure C1-5 describes one of the revised games.) The groups then tried playing their own games with the new rules.

At our next session, the class decided that they would like to do two things:

- Develop a questionnaire to find out the game preferences of others in the school
- Make the games completely ready to be tried out by another class

The Games Group first discussed where the rules for each game should be placed. Most of the children felt that they should be placed somewhere on the game so that they would always be available. They also suggested that a game booklet of all the games be made and given to other teachers.

After deciding that they should use a second-grade class to test the games, several children were delegated to invite one of the second-grade classes to do this the next week. The group then looked over the games and repaired those that needed it.

The Questionnaire Group developed two surveys, one for children and one for teachers (see Figures C1-6 and C1-7). They then went around to all of the classrooms in pairs to set up a schedule for giving the surveys to each class.

Later in the week the Questionnaire Group distributed surveys to each classroom. They asked each teacher to give her class the surveys sometime during the day. They then returned to pick them up at the end of the school day. The group received about 400 surveys from the other classes.

In preparation for the second-grade class, the children set up their games in the library. There were eight games available for the second graders to play:

Trip Through the Forest (board game for five players)

Right and Wrong (board game for two players)

Doll House (board game for four players)

Number Chase (board game for two through five players)

Treasure Hunt (active game for any number of players)

SURVEY

1.	Do you like jumprope?	yes no
2.	Do you like board games?	yes no
3.	Do you like races?	yes no
4.	Do you like relay races?	yes no
5.	Do you like basketball?	yes no
6.	Do you like pompom?	yes no
7.	Do you like kickball?	yes no
8.	Do you like games that you play outside?	yes no
9.	Do you like games that you play inside?	yes no
10.	Do you like card games?	yes no
11.	Do you like games with cars in them?	yes no
12.	Do you like games you play with a ball?	yes no
13.	Do you like a team game?	yes no

How old are you? _____

Are you a girl or a boy? _____

Figure C1-6

Monster (board game for three players)

500 (active game for five or more players)

Teeter totter (active game for three or four players)

After each group had told me the number of children that could play their game, the correct number of second graders were assigned to each group. When the second graders finished the first game, they went to other groups to try some of the other games. Most of the children were able to play three games. Some of the groups had difficulty in teaching the rules and keeping score, but all enjoyed the session very much.

When the second-grade class returned to their room, the teacher asked them which games they liked and why. The results, as reported to our class, are as follows:

Game	Number of Children who liked it	Why they liked it
Monster	21	the name, it had little people with it
500	16	liked throwing beanbag in the basket
Teeter totter	13	liked the balls
Trip through the Forest	13	liked the two big blocks used as dice
Right and Wrong	11	liked picking papers from cup
Treasure Hunt	9	liked hiding the box and finding the box
Doll House	8	play money to buy stuff

TEACHER SURVEY

1. Would you like board games for your room? yes no
2. Would you like long games for your room? (1/2 hour or more) yes no
3. Would you like short games for your room? (up to 1/2 hour) yes no
4. Would you like games for outside? yes no
5. Would you like games for inside? yes no
6. Would you like miniature ball games? yes no
7. Would you like games that teach things? What would you like taught?

Room Number _____

Figure C1-7

At our next session I held up the stack of surveys that had been completed by the other classes and asked the class what we should do with them. One girl suggested that we should divide the class into groups with each group taking the surveys from one class. Using sticks, each group would tally the number of yes votes and no votes for each question. These results could then be listed next to the number for each question.

The class decided that this was a good idea. After the class had divided into groups, I handed out the surveys and a plain piece of paper for tallying. Each group proceeded to tally the results using their own method. The groups spent several days tallying their results and recording the number of votes. (See Figure C1-8.)

When all the groups had finished, I asked the class how we could make the results easier to read. The children decided that they should write the questions down and then list the number of yes and no votes for each question. When I asked how they could do it for people who could not read, one child suggested that they could draw a picture for each question. The groups then began recording the data (using either a written question or a picture) in this way. (See Figure C1-9 for a list with pictures.)

When several groups had finished recording their data, I gave them a piece of graph paper and asked them to figure out a way to show their information in picture form, reminding them of the graphs we had constructed earlier. Each group experimented with various ways. When one girl noted that she did not have enough squares to fit all the responses to one question, I asked whether she would have enough squares if each of them counted for more than one answer. She decided to let each square stand for five answers. But when she got to twenty-two, she did not know how to mark her graph. Because each square was equal to five answers, she decided that she could divide each square into five parts. She then marked four squares and two parts of the next square to show twenty-two.

Most of the other groups were having difficulty with their graphs. I asked another teacher, whose students had just learned how to make graphs, if she could send some children to the class to teach the children in my class. Eleven students came to the class to help with graphing. Each picked a pair of students to work with and showed them how to set up the graph. They then watched each pair as they filled in the data to make sure there were no mistakes. (See Figure C1-10 and C1-11 for samples of these graphs.)

1 Do You Like Jumprope	yes 11	No 11
2 Do you like Board games	20	1
3 Do you like Races	15	6
4 Do you like Relay Race	16	7
5 Do you like Basketball	16	8
6 Do you like Pom Pom	12	10
7 Do you like KkK Ball	20	5
8 Do you like outside game	19	6
9 Do you like inside games	20	4
10 Do you like card games	19	7
11 Do you like car games	20	7
12 Do you like ball games	16	8 1
13 Do you like team game	17	6

Figure C1-8

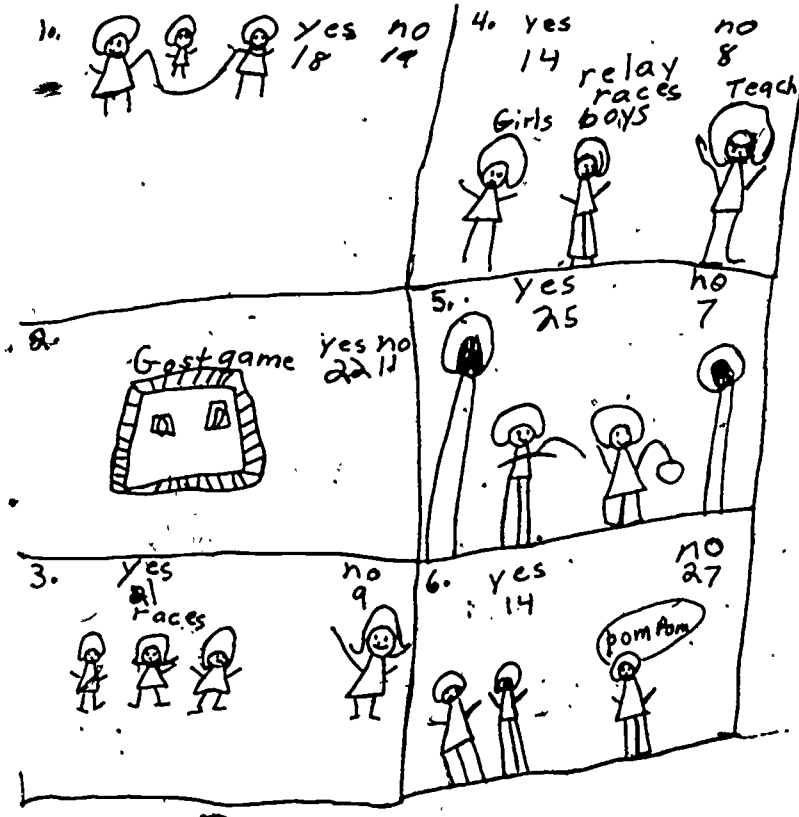


Figure C1-9

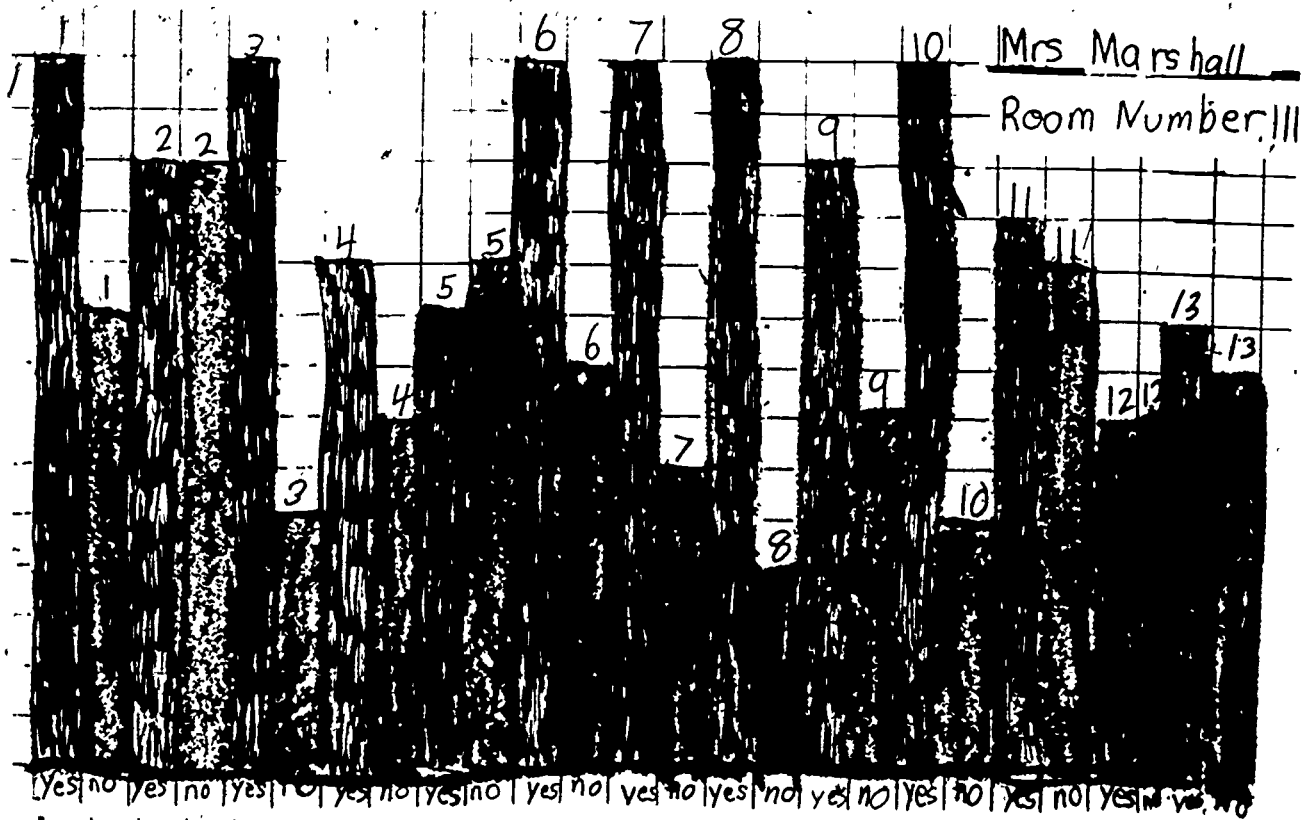


Figure C1-10

5 people = one box

- Jumprope
- Board games
- races
- relay races
- Basketball
- pompom
- Kickball
- outside games
- inside games
- card games
- car games
- team games

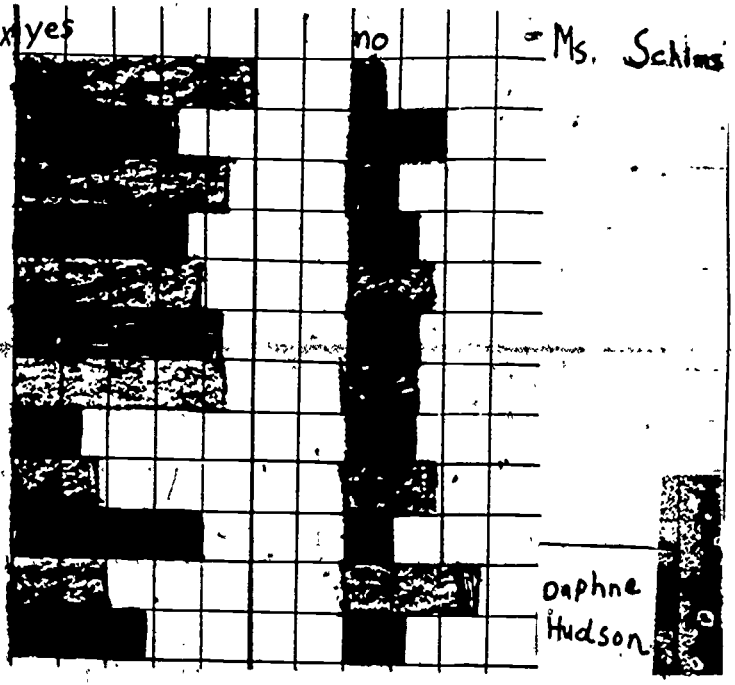
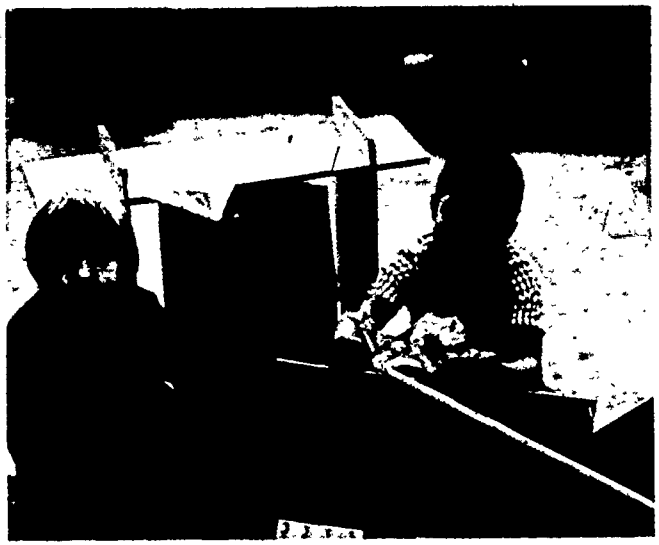


Figure C1-11



When the graphs were completed, each group listed the types of games that the children in that class had liked the most. (We first eliminated items that were already games such as kickball.) The groups then picked one of the more popular categories of games that were left, such as card games or board games, and began developing ideas for games for the particular class whose surveys they had analyzed. Each group planned to make games for a particular classroom and then teach that class how to play them.

All of the groups worked on developing games for their particular class for several weeks. Some groups worked on card games or board games, others made up relay race games. When the children requested specific items (marbles, dice, play money) or needed time in the Design Lab, I helped them with these things.

The children seemed to find it much easier to develop new games than they did at the beginning of the year. They knew what components were necessary for each game and included these in their written descriptions of the games.

Descriptions of two games developed by the class are as follows:

Fishing Game: For four players.
Equipment: paper fish, box, fishing pole, magnet.
Directions: Paper fish with paper clips attached to them are placed in the box. Players use a fishing pole with a magnet on the end of it to catch fish. When the fish is caught, player must answer the math problem on the back of the fish. If the answer is correct, player keeps the fish. If not, fish is put back in the box. Player with most fish wins.

Fire Escape: For six players.
Equipment: board, six markers, two dice.
Directions:
1. Throw the dice.
2. Lowest number goes first.
3. Shake the dice and move that number of spaces.
4. If you land on the fire, you must move down the ladder.
5. Person who gets back to start first wins.

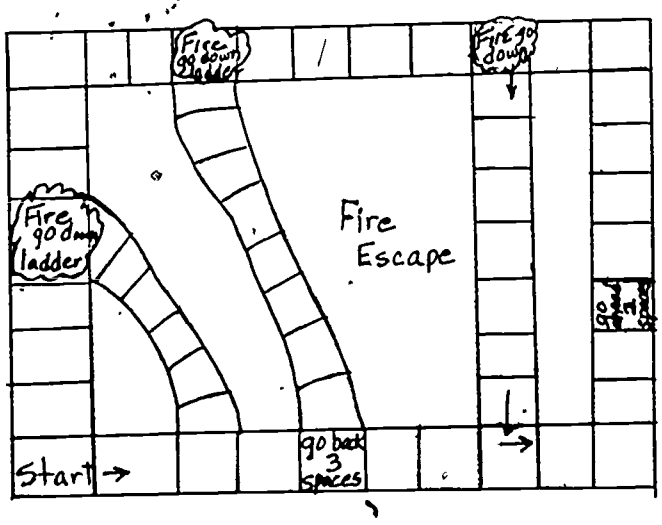


Figure C1-12

A picture of the board for Fire Escape is shown in Figure C1-12.

As the children finished their games, I would ask them to check whether they had the following information:

- Name of the game
- How many can play
- Equipment needed
- Who starts first
- How do you play game-rules
- Who is the winner

When the groups had finished most of their games, we rearranged the room and set up the completed games for a "Play Day." The groups first tried out their own games and then circulated around the room trying out some of the other games. All enjoyed this session very much.

At our next session we discussed how much additional time would be needed for all groups to finish at least five games for their assigned classes. It was decided that two weeks would be enough time.

I noticed that several interesting things have occurred as the children have developed their games.

1. Children working on games involving math problems have gone to their assigned class to find out what types of problems would be of interest to that class. They have returned with books or worksheets showing examples and have used these in developing the games.

2. Children are now aware of the components of games and are constructing more complex games than they did before.

3. Several groups that have been finished with their games for some time have asked if they could make more games, which they had already designed during free time prior to class.

By the end of the two-week working period, all groups had finished their games, and the class held a discussion on how to teach their games to the other classes. We set up the following guidelines:

- About a week before the teaching day each group would set up a convenient time with the teacher.

SURVEY

1. Do you like the games we made?
   1. yes_____ no_____ Why?
   2. yes_____ no_____ Why?
   3. yes_____ no_____ Why?
   4. yes_____ no_____ Why?
   5. yes_____ no_____ Why?
   6. yes_____ no_____ Why?
2. Were any of the games too easy? Which ones?
3. Were any of the games too hard? Which ones?
4. Was the math too hard in any of the games?
   yes_____ no_____
5. Which game did you like the best?
6. Would you like some more games? yes_____ no_____
7. Do you think that you could make your own games now that you have seen ours? yes_____ no_____

Figure C1-13

- The groups would ask the teachers for a one-hour session to teach the games.
- The day before the teaching day, each group would give the teacher directions on how his/her class should be arranged.
- Each group would take their games to the assigned class when they went to teach, not before.
- The games would be left in the classroom for three days in the kindergarten and two days in grades one through six.

The class next discussed what they would do with their games after the assigned class was finished with them. Most of the children wished to take them home, but one group of about eight children was interested in compiling descriptions of all of the games into a book.

I asked the class if they wanted to know whether the other classes liked their games. When all said yes, I asked how we could find out. One boy suggested that a survey be taken after the classes had finished playing with the games. The children then formed two groups, Survey Group and Book Group, and began to work on these ideas.

The Book Group decided the following:

1. They would place the rules for each game, a picture of the game, and the names of the people who made that game on a ditto sheet.
2. The ditto sheet would be typed.
3. They would make copies for everyone in the room, all teachers in the school, and the principal.
4. A cover would be made for the book.

The Survey Group developed a survey to be given to the other classes. (See Figure C1-13.)

During the next few weeks, the groups took their games to their assigned classes. Most groups spent about forty-five minutes teaching their games. All of the classes visited seemed to enjoy the teaching and playing sessions very much. Each group then returned to their assigned class several days later to conduct the survey.

The question was again raised as to what should be done with the games after each class was finished with them. The majority of our class was opposed to giving the games to the other classes, but two suggestions were made that received general approval:

- Sell copies of the games
- Put all the games in a book and sell the book

After discussing both possibilities, the children voted to put all the games in a book to be sold to others.

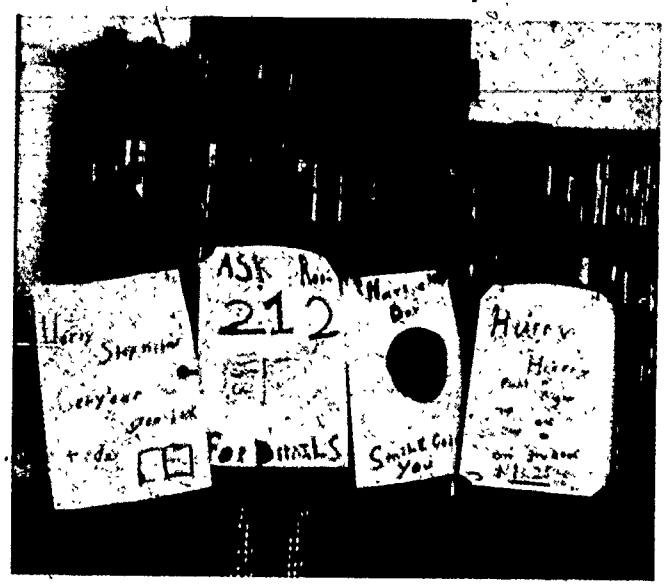
At their next session, the class revised the list of things that should go in the book for each game:

1. Artist (draw pictures)
2. Directions (rules)
3. Made by
4. Name of game
5. Date when made

After deciding on a name for the book (Games and Rules from 212) and voting to use alphabetical order for the games in the book, the class discussed the work that would be needed on the book. After deciding that four kinds of jobs (artists, writers, ditto runners, and salespersons) needed to be done, everyone signed up for the job he/she wished to do.

During the next two months, most of the children worked in groups to complete the book. The Salespersons Group worked on advertising and taking orders for the book. They used sample pages of the book for some of their ads. The writers and artists divided each page in half vertically with the picture placed on the left and the rules on the right. As they worked, they switched jobs periodically to avoid boredom. As the ditto runners had nothing to do during the first week or so of work on the book, I challenged them to think of other ways to use their free time. Each child developed a list of things to do and then chose one of those things to work on. Two girls who had decided to help other teachers with art, math, and reading during their free time designed posters advertising their services. Another group of children planned to construct an art show with various types of artwork displayed. The show would be circulated to other rooms in the school.

As work on the book continued and other children completed their tasks, they also developed lists of free-time activities and began work on an activity of their choice.



When the artists and writers had completed all of the games, the ditto runners spent two sessions running off forty copies of each page (enough copies for everyone in the class and extras to sell). The whole class then set up an assembly line to put the book together. The completed books were distributed to each child in the class and to all those who had ordered them earlier. See Figures C1-14, C1-15 for sample pages. The books were sold for $1.25 each and the money was put aside to be used for a trip to the zoo.

As we began to complete work on the unit, one group of children volunteered to make a chart listing all the children's names and the free time activities that they had listed. This was completed and placed in the classroom for easy reference.

Our last task was to tabulate the results of the surveys that had been conducted after the teaching of the games in each room. After a brief discussion of how the graphs had been made before, the children constructed bar graphs of their data.

During the remainder of the school year, the children utilized their chart on free time activities and continued to work on many different projects.

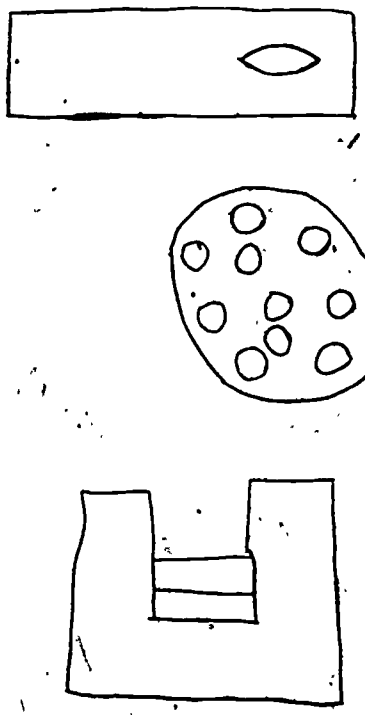


Figure C1-14

Name: Teeter Totter

Object of the Game:

The person with the most points after 2 turns wins.

Equipment: teeter-totter box, whiffle ball

The Play 3-4 players

1. place the ball on the teeter totter.
2. Hit the teeter totter to flip the ball into the box
3. Each turn take 3 tries
4. Take 2 turns

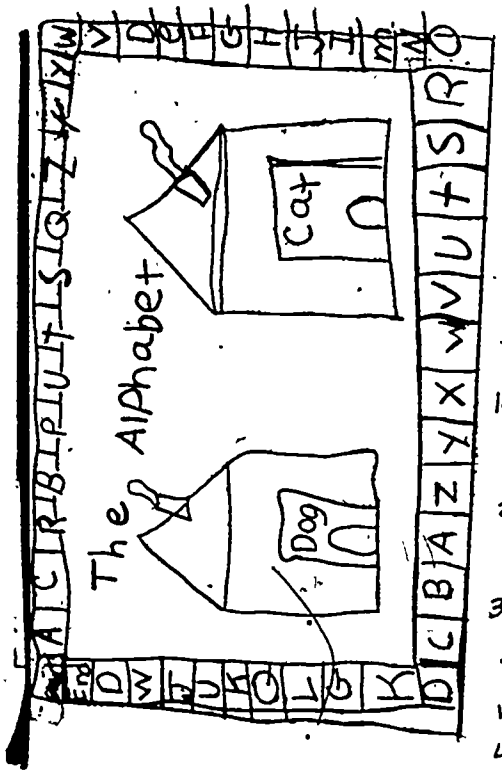


Figure C1-15

Name: The Alphabet

OBJECT of THE Game:

The person who goes around the board first wins

EQUIPMENT:

board markers 1 dice

The Play: 3 players

1. Start in this order: red, yellow, orange
2. Shake the dice and move the number
3. When land on a space say a word beginning with that letter.
4. If miss, go back to start

2. LOG ON USING FREE TIME

by Marie Salah*
Hosmer School, Grade 4
Watertown, Massachusetts
(October 1974-February 1975)

ABSTRACT

This fourth-grade class at the Hosmer School in Watertown, Massachusetts, designed and constructed board games to play during the lunch period when inclement weather prevented them from going outside. Spending approximately two hours per week on the games, the class worked in small groups. Each group considered game rules, the number of people who could play the game at one time, game materials, and whether the game was fair or not. To test game fairness, the groups tallied the number of times each player won over a certain number of games. During class discussions, the games were evaluated (by a survey) by each small group. Another survey was conducted to determine the most popular game. Later in the year, some of the children became bored with their games and began a school services program. The children made games for other classes and helped teachers clean their rooms.

By the month of October my children were no longer going outside for recess after eating their lunch. Instead, they remained in the classroom to read a book, talk quietly with a friend, or play a game. The lunch aides supervised the class during this time. After several hectic lunch periods in which children were running around the room, throwing aluminum foil, and sliding on the floor, I gathered the class together to discuss what was happening in the room while I was out. The children readily admitted to these misbehaviors but offered the following reasons:

1. The regular teacher is out of the room.
2. The lunch aides are not strict enough.
3. There is nothing to do in the classroom during this time.

*Edited by USMES staff

We agreed that it would be difficult to change the lunch aides' disciplinary habits. The children also agreed that it would not be fair to make the classroom teacher remain in the room during her lunch break. Because the first two situations were not changeable, we looked hard at the third complaint of nothing to do. From the time they had to remain inside, the children occupied themselves by chatting with friends. They offered other types of activities they could do which included the following:

1. Read a book
2. Finish incomplete work
3. Play games

Because there were games in the room, we discussed why they were not used as often as they could be. The children's main complaint was that there were not enough games for everyone to play. The children suggested two ways we could resolve this problem:

1. Bring in games from home
2. Make our games

Many children were against bringing in their personal games from home. With so many children using it, the game would soon become dilapidated or parts would be lost. Most of the class agreed that making games was more feasible and practical. Since few children expressed interest in reading books or completing unfinished school work during the lunch period, the class enthusiastically accepted the challenge of making games to play during indoor recess to make this time more enjoyable.

The children offered many interesting ideas of possible games. Most of the games suggested were either fun-type games, such as board games (similar to Parcheesi and Monopoly), or learning games, such as manipulative games and games that reinforced a math or language arts skill (addition, subtraction, spelling, etc.). Before breaking into groups of two or three, we briefly discussed what they would have to consider in designing their games. We agreed on the following considerations:

1. Game instructions
2. Game rules
3. Number of players
4. Game equipment
5. Game safety

For several days the groups drew sketches and wrote drafts of game rules. Once the groups knew basically how their games were played, we got together as a class to share designs and rules. Each group chose one member to sketch the game on the board and explain how to play it and what the rules were. The class offered suggestions for improvement.

The class spent several weeks constructing their games in the Design Lab. When most of them were completed, we looked at them and agreed that, physically, they could use improvements. Most of the groups had used regular cardboard and paper, rather than sturdier materials. Also, many children had drawn the games with either pencils or pens. The children agreed that Tri-Wall and oaktag would make their games more durable. They suggested three ways to make their games more appealing:

1. Make the game pretty by using crayons, paints, or Magic Markers.
2. Play the game in front of other students so that they may see how much fun it is.
3. Tell students about the game (advertise it).

For the next two months the groups improved and revised their games and solicited suggestions and criticisms from their classmates. Although all the groups worked simultaneously, this log documents each group (game) one at a time.

One-Two-Three Match Up

This game was one of the first games to be shown to the class. It could be played by three or five students. The game instructions were as follows.

1. If three people play, one player is chosen as a caller. The remaining two players are two teams.
   If five people play, one player is chosen as caller. The remaining four players divide into two teams.
2. The caller shuffles the cards and deals an equal number of cards to each team. The cards have pictures and numbers on them.
3. Each team takes its cards, looks at them, and then picks one to put face down on the table.
4. After the caller calls "One-two-three Match Up" each team turns over its cards.

5. If the cards match (both picture and number), the pair goes to team one. If the cards do not match, the pair goes to team two.
6. Whichever team has the most pairs, when all the cards have been exhausted, wins the game.
7. Each game consists of one round.

One boy quickly pointed out that the player receiving the unmatched cards would win most of the time. The girls admitted that after having played the game seven times, the unmatched cards recipient won six times. The girls agreed that revisions were needed.

Dinosaur Fish

This game was designed to be played like the game Fish in which players try to find matched pairs. Rather than match numbers and figures (hearts, clubs, etc.), the players had to match prehistoric animals drawn on oaktag with Magic Marker.

In showing the game to the class, the boys explained that they were having problems with the cards because a little bit of the Magic Marker showed through on the back side. The class offered two possible solutions:

1. Use crayons
2. Double the thickness of the cards using glue or staples

The boys decided to cut the dinosaur figures out and paste them on new oaktag cards. They also decided to write the name of the prehistoric animal on the card. To assist in pronunciation, they broke the name into appropriate syllables.

ABC Math Game

This board game consisted of every space having the instruction "Pick a card" on it. Each player moved his marker the number of spaces as indicated by a throw of dice. The player could pick either a math card or an ABC card (spelling question). If the player's answer to either the math or ABC card question was correct, the player moved his marker two spaces forward. If the answer was incorrect, he moved his marker back two spaces. The winner was the first player to get to the other side of the board.

The class felt this was a good learning game. However, many of the students felt there should be a time limit for

answering the questions. Various simple timing devices were suggested:

1. Three-minute egg timer
2. Drop something from the same spot each time (they would have to time each drop until they found the appropriate time they wanted)
3. Modification of the three-minute egg timer--use a paper cup and sand

The girls agreed that a timing device was a good idea. In the end, they chose to drop a feather from the same spot each time.*

Nuts and Bolts

This game consisted of matching bolts with appropriately fitting nuts. Problems, such as math multiplication questions, were tied to the bolts, and the answers were tied to the nuts. The player had to match the appropriate nut with the bolt. If the match was correct, the nut screwed onto the bolt. The children made several modifications to this game to accommodate various age groups. These modifications were as follows:

1. Very young children--match the nuts and bolts correctly in one minute. (No problems attached to the nuts and bolts.)
2. First graders--perform the correct addition by matching the appropriate nuts and bolts. To learn color names the children could tie color samples to the bolts and tie the color name on the nuts.
3. Fourth graders--perform the correct multiplication/division by matching the appropriate nuts and bolts.
4. Time limits--increase the time allotment of matching the nuts and bolts for younger children.
5. Number of nuts and bolts--increase the number of nuts and bolts for older children. For really advanced children, add nuts and bolts with no match.

The boys explained that they resorted to tying the problems on the nuts and bolts after masking tape kept falling off and Magic Marker kept rubbing off.

*The children might check to see if the feather always takes the same amount of time to drop a certain distance.--ED.

Hot Shot

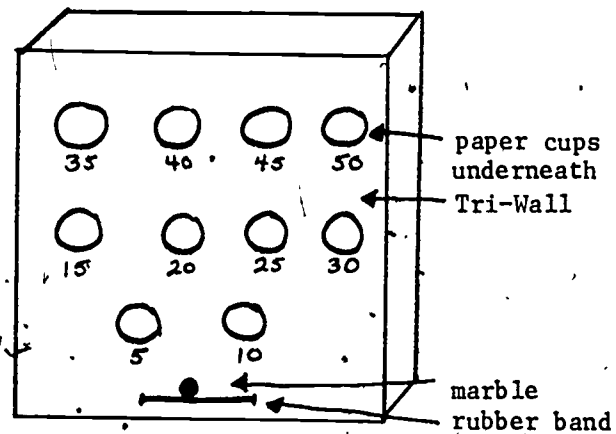


Figure C2-1

Seth

GAMES WON

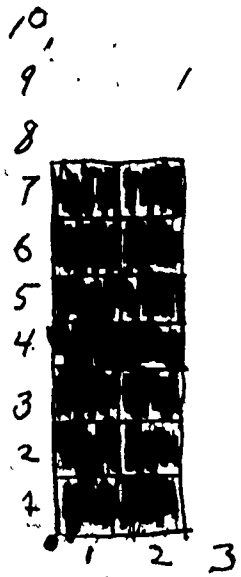


Figure C2-2

117

Hot Shot

Considerable time was spent building the game "Hot Shot." The game was like pinball and made from Tri-Wall, paper cups, and a rubber band. Figure C2-1 shows a drawing of the game. The rules were very simple:

1. Two to four players can play.
2. Each player gets four tries to put the marbles in various cups worth different points.
3. The winner is the first one to get a total score of fifty.

Roadway Game

This game was a board game where the players proceeded to designated spaces by tossing a die. Various spaces had instructions on them such as "Go back to gas station," "Take detour," etc. The winner was the player who reached the other side of the board first.

Each time a game was presented the class considered whether it was fair or not. The children felt that if each player won approximately the same number of times, then the game was fair. After all the games had been presented, we decided to test each for fairness by playing the games and tallying the number of times each player won or lost. The class spent several weeks playing them. The various groups rotated the games so that each group played every game. Figure C2-2 shows the tally results of the Roadway game.

A survey was made to obtain the players' opinion of each game. After a game was played, the players completed the survey and left it with the game authors. Figure C2-3 shows the survey used by the group.

To determine which games were most popular, they designed another survey listing all the games that had been made. The respondent was requested to check the two games that he liked best. The surveys were tallied, and the results revealed that the game Hot Shot was the favorite. The total tallies for each game were as follows:

ABC Math Game	4
Travel Month Game	1
Railroad Game	0
Match-up	4
Hot Shot	14
Nuts and Bolts	3
Roadway Game	3

113

Spelling Race Game	3
Moon Game	1
Dinosaur Fish	1

After the games had been played for one month, we evaluated the success of them in terms of the challenge of finding things to do during lunch period. Several children complained they were tired of their games and wanted to make new ones. Others complained that the lunch aides would not allow them to play the noisier games, such as "Hot Shot." A group of boys, who had played their game on the floor because so many wanted to play, complained that people accidently stepped on the game while they were playing upsetting the board. We decided to list again what we could do to resolve this problem:

1. Make new games but limit the number of players so that the game can be played at a desk.
2. Sit and chat quietly with a friend.
3. Finish incomplete work.
4. Read.
5. Help the librarian or other teachers.

Each suggestion was discussed again. The children who were interested in making new desk games decided to make them using the vertical file folders that I had brought. Many children were enthusiastic about the last idea because this activity allowed them to leave the room. We talked about whether this idea was feasible in terms of amount of time. Most of the interested children agreed that it took them only five to ten minutes to eat their lunch, leaving them ample time to help other teachers. We agreed that everyone could not leave the room at one time because of the following reasons:

1. It would be too noisy.
2. Some of the students would fool around in the hallway.
3. Other teachers would complain that too many students were in the hallway unsupervised.

To avoid the noise problem, the students suggested the following ideas:

1. Go out quietly.
2. Leave one at a time.
3. Let two students leave every five or ten minutes.

Hot Shot

Game Survey Sheet

1. Is the game too hard or too easy? no
2. Is the game durable? - Will it break easily? No
3. Do you understand the rules? yes
4. Did you enjoy the game? yes
5. Is the game safe to play with? for both kg & 1st yes kids yes
6. Is it a fair game? yes
7. Do you want to play the game again yes
8. Does it take to long to play? No
9. Can you read the directions to the game? yes
10. Is your game to noisy for a classroom indoor recess games? NO

Sheila Delaney

Figure C2-3

4. Rotate the jobs so that everyone gets a chance to help and so that everyone does not leave the room at once. A schedule can be made.

Several boys expressed a preference to remain in the room, but they agreed to make any games that other teachers requested. Several girls decided to interview the primary teachers to determine whether they needed the fourth graders' assistance in any way. By the end of the day, the children found eight teachers who wanted to use the fourth graders' services.

A schedule was set up that included the teacher's name, the services she wanted the fourth graders to do, the time, and the day. Students were then assigned the various tasks on a rotating basis. The schedule of teachers requesting assistance, the time, and the type of assistance needed is shown below.

HELPING AT LUNCH

DAY	TEACHER	TIME	WHAT TO DO
Thursday	Miss Powers	11:30 - 12:00	Helping Librarian
Monday, Wednesday	Miss Forte	11:30 - 12:00	Games and stories
Every day	Miss Dowling	11:30 - 12:00	Cleaning up
Any day	Miss Fitzpatrick	11:45 - 12:00	Reading
Friday	Miss Nutting	11:30 - 12:00	Games
Any day	Mr. Arone	11:30 - 12:00	Helping in the Reading Room
Monday, Friday	Miss Pane	11:30 - 12:00	Help with work
Monday, Wednesday, Thursday	Miss Lane	1:00 - 1:30	Reading
Tuesday, Wednesday, Thursday	Miss Norton & Miss McGrail	9:30 - 10:00	Help with work
Monday, Wednesday, Friday	Miss Malva	11:30 - 12:00	Games

For three weeks the class either made games for other teachers or helped clean other rooms.

1. The students who made games for the new EDCO Reading program had to read the directions for various activities in the teacher's manual.

They then reproduced activities (games) shown in the manual. Although these games were not original, the students were enthusiastic because they knew they were helping the EDCO Reading program.

2. The students making the primary games created games that reinforced skills and concepts that the small children were learning. Some of these games included math bingo and initial consonant "fish."

The program was so successful that several of the other teachers asked that the students continue their activities the following year with their new teacher.

3. LOG ON USING FREE TIME

by Marion Perkins*
Whitehead Road School, Grade 5
Athens, Georgia
(November 1974-February 1975)

ABSTRACT

*This fifth-grade class at the Whitehead Road School in Athens, Georgia, designed and constructed active indoor games in response to the challenge of making more interesting games to play during indoor recess.** The class spent approximately two hours per week making these games. Recognizing the limitations of the classroom, the children decided to adapt for indoor play their favorite active games. To determine what active games were favorites, the children designed and conducted a survey among themselves. Each child rated the twenty-two active games that the class listed; there were five ratings in the scale. In order to compare the games relative to one another, each rating was assigned points. By multiplying the points by the number of votes for each game rating and adding up the totals for each rating, the children obtained a total score for each game. The class administered this same survey to other classes in order to determine whether these other classes would rate the games in a similar way. Recognizing that they could not possibly survey all the children, the class agreed upon a suitable sample size. During the month of January the children designed and constructed the games.*

Indoor recesses at the Whitehead Road School are not enthusiastically received because there is no school gym and the children must remain in their classrooms during this period. After several consecutive rainy days of indoor recess and the resulting boredom from playing the same old board games, we talked about what we could do to remedy this situation. The children expressed an interest in designing and making new games for the classroom. Therefore, I challenged them to design active games that could be played within the confines of the classroom.

A discussion of the challenge followed. The class decided to eliminate board games and to concentrate on active games.

*Edited by USMES staff

**During the year the challenge was broadened to include other types of activities besides games.--ED.

Several children were ready to devise a game immediately; other children thought we should consider some of the limitations for indoor active games. The class agreed that in designing a game, the children would need to consider the following:

1. the size of the room
2. the noise level
3. the degree of activity involved in playing the game
4. safety factors

The class next considered what kind of active games they enjoyed playing. Favorite games were mentioned and discussed. An argument ensued when I asked what the favorite two or three games were. Because the class did not know, one child suggested that we conduct a survey in the classroom. Another child suggested that if the class knew the favorite outdoor games, they could use this information to determine the kind of games they should design for indoors.

A checklist survey was designed in which the respondent registered his feelings towards each game by checking an appropriate rating. The class then brainstormed the following twenty-two active games to be included in the survey:

beanbag toss	volleyball
Twister	Blind Man's Bluff
Four-Square	Capture the Flag
kickball	box hockey
basketball	putt-putt golf
benchball	Steal the Bacon
dodgeball	tag games
bowling	Cranes and Crows
battleball	Run-Down
baseball	Drop the Handkerchief
Keep Away	racquet games

The five opinion categories included the following:

1. I love it (the game).
2. I like it.
3. It's O.K.

4. I don't like it.

5. I hate it, or I don't know how to play it.*

One student was delegated to put the questionnaire on a ditto master and to give it to the teacher aide. During the week the class completed the survey.

In order to tally the surveys, the class decided to have one student count raised hands for votes in the opinion categories for various games. Using the overhead projector, the totals were recorded on a transparency of the questionnaire. The total tallies appear in Figure C3-1.

In order to compare the relative popularity of each game, the children assigned points to each opinion category so that the category "I love it" was assigned five points, "I like it" was assigned four points, down to the last category of "I hate it" which was assigned one point. By multiplying the points by the number of votes for each game rating, the children obtained a total score for each game. The children arrived at the totals shown in Figure C3-2.

Total Votes for Each Game's Position

	I love it	I like it	It's O.K.	I don't like it	I hate it - I don't know how to play it	Total Votes Per Game
Beanbag toss	2	6	15	0	0	23
Twister	15	3	3	0	5	26
4 Square	4	8	11	2	2	27
Kickball	13	2	4	2	3	24
Basketball	16	3	3	2	4	28
Benchball	6	1	0	1	18	26
Dodgeball	9	8	8	3	0	27
Bowling	15	4	1	0	6	26
Battleball	8	3	1	1	13	26
Baseball	14	2	7	0	4	27
Volleyball	7	7	7	1	4	26
Blind Man's Bluff	7	3	3	3	8	24
Capture the Flag	6	1	1	2	14	24
Box hockey	6	3	4	3	11	27
Putt Putt golf	19	2	1	0	3	25
Steal the bacon	3	5	7	3	7	25
Tag Games	11	1	10	2	2	26
Cranes & Crows	2	5	4	4	11	26
Run-Down	13	4	1	2	6	26
Drop the Handkerchief	4	2	3	4	12	25
Keep-Away	7	6	3	1	8	25
Racquet games	14	5	4	2	2	27

Figure C3-1

Game	Points	Game	Points
1. Basketball	109	12. Volley ball	90
2. Putt-Putt golf	109	13. Box hockey	83
3. Racquet games	108	14. Beanbag toss	79
4. Dodgeball	107	15. Keep Away	78
5. Baseball	103	16. Battle Ball	70
6. Twister	101	17. Steal the Bacon	69
7. Bowling	100	18. Blind Mans Bluff	68
8. Kickball	98	19. Cranes and Crows	61
9. Tag games	95	20. Drop the Handkerchief	58
10. Run-Down	92	21. Capture the Flag	56
11. Four-Square	91	22. Benchball	54

Figure C3-2

*The children might discuss how they would deal with answers to this question. Would they count each check as a negative response towards the game or just as an unknown?--ED.

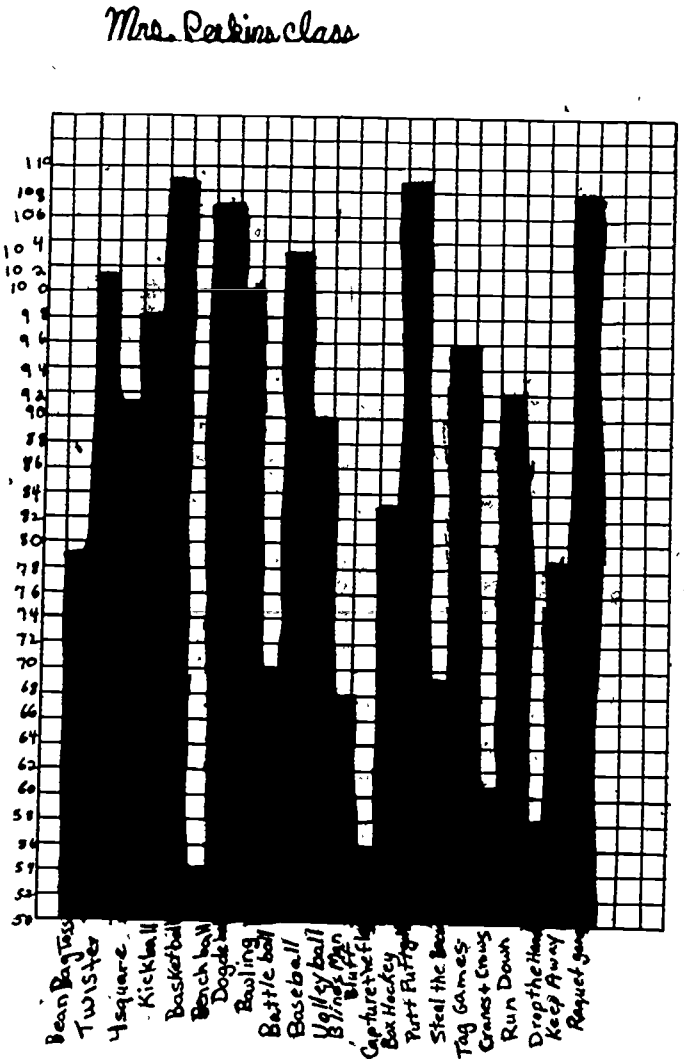


Figure C3-3

When we had completed the calculations we compared the totals of each game. Many children had predicted that kickball would be the favorite game and were surprised that basketball and putt-putt golf were the top two favorites.* The top eight games were the following:

basketball	baseball
putt-putt golf	Twister
racquet games	bowling
dodgeball	kickball

The class graphed the game totals. The high math group proceeded on its own, graphing the data without trouble. The middle math group graphed the data with some assistance from the graphing "How To" Cards. The low math group was given a skill session on graphing. I used the overhead projector and graphed the first few game totals. The children completed the graph on their own. Figure C3-3 shows one child's graph.

Many children wondered whether other classes would consider the same games as their favorites. We decided that it would be fun to find out this information. In no time, the children discussed the possibility of having every student in grades three, four, and five take their survey. However, it soon became quite evident that this total number of students would be enormous. We therefore talked about survey techniques and sampling. I explained the concepts of random samples and stratified random samples. Based on this discussion, the class decided to survey every fifth boy and every fifth girl on the alphabetical class list in all the classes in grades three, four, and five.

The day the survey was administered turned out to be quite chaotic. Children seemed to crawl out of the woodwork to take the survey. The number of students involved was more than the class had anticipated. The class eliminated some of the confusion by picking the sample in a class and letting the student teacher or aide take the rest of the class to the playground.

After the survey was administered, the total number of survey sheets were divided evenly among the children, who in turn tallied them. These totals were then combined so that

*The children might look at the results and determine where there was a natural "line" between very popular and less popular games.--ED.

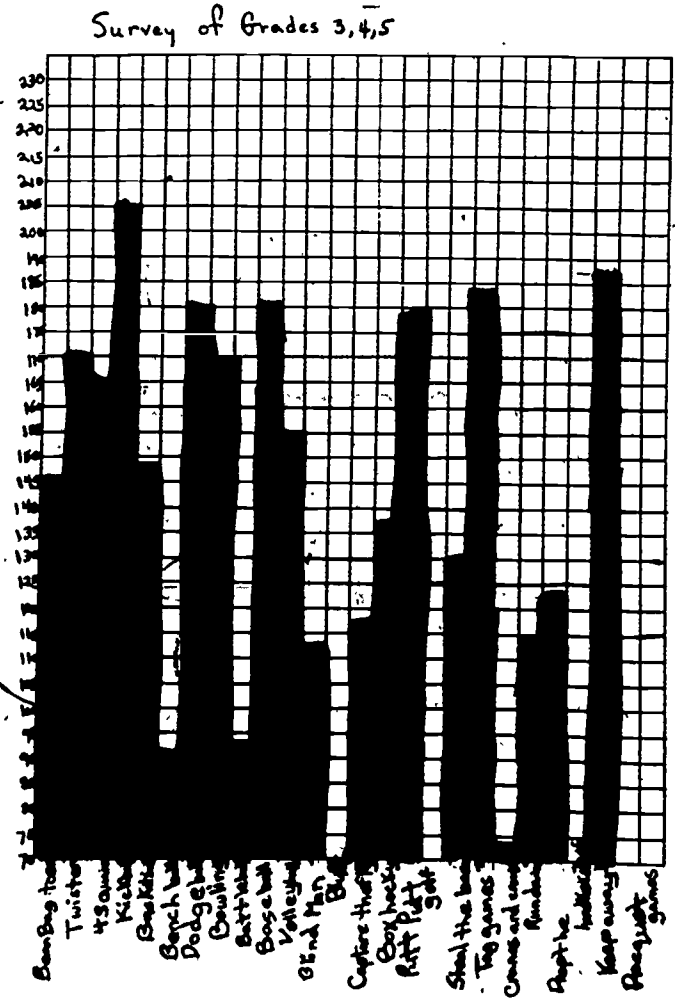


Figure C3-4

each category had only one grand total. Again, five points were assigned to the "I love it" category, four points to the "I like it" category, and so forth. Totals were again calculated for each game. Several children graphed these totals. Figure C3-4 shows one child's graph.

We compared the survey results of our class with the other classes and discovered that they were quite different. Only three games--putt-putt golf, dodgeball, and baseball--were in the top six games in both samples. Kickball was the most favorite game of the other classes.* The top eight games were:

kickball	baseball
Keep Away	putt-putt golf
tag games	Twister
dodgeball	bowling

After December vacation the class began designing their active games. The class divided into small groups of three and four members. Each group considered game equipment, game rules, number of players that could play at one time, and amount of space required to play the game. Each group's game was presented to the class for discussion. The children were quite interested in what the other groups designed, and many good criticisms and suggestions were offered.

During the month of January, the following games were constructed:

1. Bowling--bowling pins and a bowling backstop were made from Tri-Wall.
2. Racquets--these were made from lumber.
3. A game combining features from kickball and putt-putt golf--the player had to "kick" a ping pong ball into a paper cup.
4. A game that was a variation of Blind Man's Bluff played with teams.
5. Balloon Bop (played similar to baseball)--the pitcher tossed the balloon to a seated player who had to "bop" the balloon with his head. The player then had to get to the base by "crab-walking" or "duck-walking," etc. Fielders could

*The children might discuss similarities and differences in the top eight games. Games could then be designed that incorporated several of the most popular aspects.--ED.

not catch the balloon. Rather, they had to "bop" the balloon to the baseman who could catch it. Later, after numerous complaints that using one's head was too difficult, the group changed the rule to allow the use of one's hand.

6. Bean-bag toss--this game was designed for two teams. Team one flipped a cardboard spinner that pointed to colors corresponding to those on the target sheet taped to the floor. Team two members tried to toss the bean bags onto designated color circles. Each color was worth a certain number of points. If the bean bag fell entirely within the circle, ten extra points were given.

The children played their games for the remaining time they were indoors. The class agreed that the games had resolved their problem of boredom.

4. LOG ON USING FREE TIME

by Robert Farias*
Adams School, Grade 6
Lexington, Massachusetts
(December 1974-June 1975)

ABSTRACT

This sixth-grade class was faced with the problem of what to do during noon indoor recess when the weather turned cold and they had to remain indoors. After several weeks of playing board games in the classroom, the children began to express their frustrations at not being able to do other things, such as playing in the gym. After a lengthy discussion of the possibility of using the gym, the class realized that their concern was with the whole aspect of recess itself, both indoors and outdoors. Proposing three recess activities--outdoor sports, active games in the gym, and board games in the game room, the class presented its argument to the principal. The principal agreed to allow the class to investigate the three recess activities provided the children worked out the details. Working daily, the class divided into three groups to work on each recess activity. The outdoor sports group investigated ice skating on the pond located behind the school. The children surveyed grades one through six to determine interest. They also surveyed the teachers to determine who would be willing to supervise. Rules were established for skating, and a schedule for teachers who volunteered to supervise was arranged. The skating turned out to be a success with no problems of discipline. The games room group and the gym group faced insurmountable scheduling problems. Finally, the class resigned itself to continuing to play games in the classroom. By a hand vote they determined that chess was the favorite game among the children, and they therefore decided to have chess tournaments. They made chess boards and pieces in the Design Lab and also established playing schedules. In the spring the class organized softball games which turned out to be very popular.

The problem of noon indoor recess arose towards the end of December when the weather turned cold and the children remained indoors. During these recesses the children spent fifteen minutes eating lunch before reporting to the classroom for a forty-minute play period in which they played

*Edited by USMES staff

board games and were supervised by lunch aides. After several days of this routine, the children began to express their frustrations at not being able to do other things during this time.

The children were disturbed that they could not use the gym during noon recess. In the ensuing discussion, which became quite heated at times, the class talked about what they would have to do to be able to use the gym. Topics such as supervision, the gym schedule, fairness to other classes, and girls vs. boys using the gym were all talked about.

The children agreed that the gym schedule should be obtained from the gym teacher in order to arrange for some sort of lunch-time use. Many children felt that the other classes would object if just our class used the gym. The class agreed that they would need to survey the other upper grades to see how many students were interested in using the gym. Several girls wanted days set aside when only girls or only boys used the gym. This idea, however, was abandoned because the children reasoned that if everyone shared the gym, then everyone would be able to use the gym the maximum number of days it was available.

A few children wondered what they could do since they were not interested in the gym. These children expressed an interest in doing other things, perhaps in other parts of the building, such as the art room. With this thought, the class suddenly realized that the problem they were concerned with was the whole aspect of recess, both indoors and outdoors.

We explored the implications of an organized recess program. The main concern was that of supervision. The children realized that if other parts of the school building were made available for recess activities or if activities were outdoors, the schedules of the teacher aides would need to be altered. The children recognized that such alterations would require them to go through administrative channels. The class agreed that it was worth informing the student council about their proposal for an organized recess program.

Upon their return from vacation, the children sent word to the student council that they wanted more activities available during recess period. The student council, which is very active, passed this complaint on to the school's P.T.A. Executive Board. The P.T.A. board met with the school principal to discuss the feasibility of allowing more recess activities. The principal agreed to consider any constructive suggestions the children might have.

The children proposed three recess-time activities:

1. Outdoor winter sports, such as ice skating and sledding
2. Indoor active sports using the gym
3. A game room for board games, such as chess

In presenting their case to the principal, the children offered the following reasons for the proposed activities:

1. The children challenged the idea that snow and the cold should restrict them from going outdoors. They reasoned that if activities such as skating and sledding were offered, children would not be as cold as they would be just standing around as they did presently. They also felt that snowball throwing would stop if children had other things to do. Finally, if the gym and game room were also made available during noon recess time, the students would be spread among the three areas with no one area becoming too crowded.
2. Most of the children agreed that during recess time they should be allowed to mingle with friends in the other rooms. The gym and game room would provide such an opportunity. Again, the children reasoned that if there were available things for children to do, then there would be fewer discipline problems.

The principal agreed to their three proposals on the condition that they worked out scheduling and other problems connected with each proposal. He also suggested an outdoor sports activity, target snowball throwing. The class decided to divide into three groups to work on each aspect of the recess program.

The children interested in the outdoor sports concentrated on ice skating since the pond behind the school was just beginning to freeze over. A survey was conducted among seven of the upper grades (fourth through sixth) to determine the number of children who were interested in skating and the number of teachers who would be willing to supervise. They obtained the following numbers:

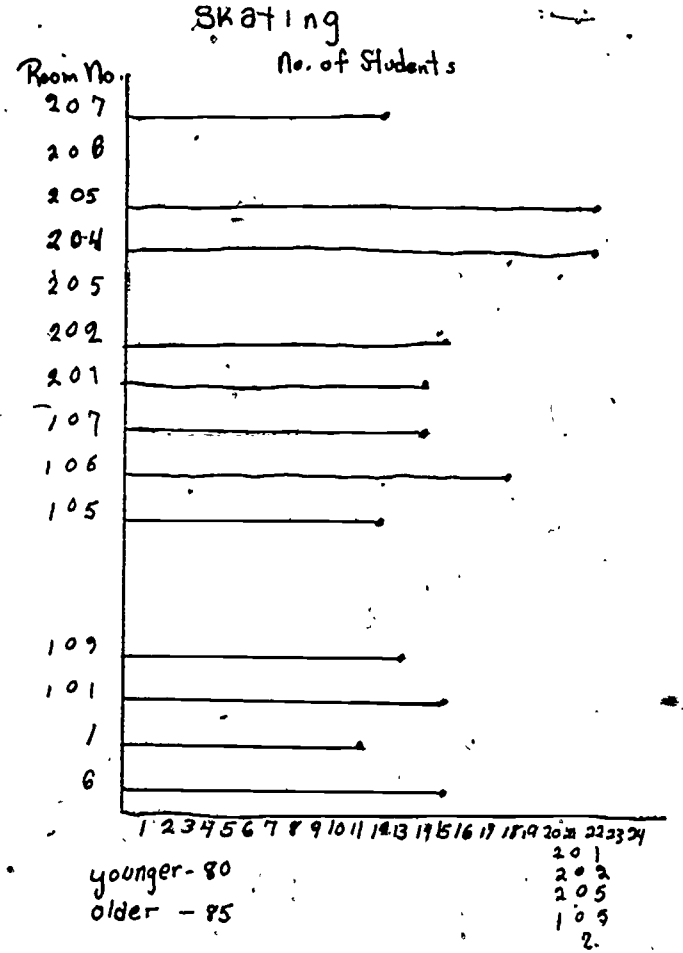


Figure C4-1

Class	Number of Children Interested in Skating
Mr. Farias	18
Mrs. Szerenyi	18
Miss Alcorn	17
Miss Wahl	20
Mrs. Clinton	19
Mrs. Arch	20
Mrs. Davidson	14
	126

Number of teachers available for supervision: 3

Several weeks later, the class noticed that their survey had not included children in kindergarten through third grade, and so another survey of grades one through six was conducted. (The kindergarten children were excluded because they were on a half-day session.) The results of the second survey revealed that eighty primary children (grades one through three) and eighty-five intermediate children were interested in skating.* Six intermediate and one primary teacher were available and willing to supervise the skating. Figure C4-1 shows one child's bar graph of the data from the second survey.

After a discussion with the principal and me, the children decided to eliminate grades one through three from the skating activity. The reasons given were lack of interest of the primary teachers and problems that would undoubtedly result from putting on and taking off the little kids' skates. Several children suggested that the older children could possibly help the younger ones, but the majority of the class felt that this would cut into their lunch time and skating time. The class agreed that a possible solution to this problem would be to offer Thursday afternoon** skating with parent supervision.

The children established a schedule for teacher and teacher aide supervision but neglected to consider the French teacher's unique schedule. They rewrote the schedule to accommodate this teacher. The following was the group's final schedule:

*The children might discuss the apparent drop in interest among intermediate children from 126 to 85.--ED.

**There is no school on Thursday afternoons in Lexington. This time is set aside for teacher planning and conferences.--ED.

SUPERVISORS FOR SKATING

Beginning at 12:35 p.m., Ending at 1:05 p.m.

Jan. 27	Mr. Farias
Jan. 28	Mrs. Spinelli
Jan. 29	Mrs. Arch
Jan. 31	Mrs. Szerenyi
Feb. 3	Mrs. DerManuelian
Feb. 4	Mr. Ziehler
Feb. 5	Mr. Farias
Feb. 7	Mrs. Arch

To determine if there were really enough room for everyone to skate at the same time, the group went outdoors to measure the pond. The area measured 198 ft. in diameter with a wall down the middle dividing this area in half. The children felt that this was adequate space. They also decided to make use of the wall by designating sections of it for each class to hang its belongings, such as scarves, mittens, and hats. They established the rule that no class could go near another class's wall section.

The group made skating rules and talked about ways to enforce them. They came up with the idea of a penalty box for any violators with the supervising teacher or aide determining the length of time one had to sit in the box. The following list of skating rules was distributed to each of the involved classes:

RULES FOR ICE SKATING

1. Hockey sticks and pucks are not allowed!
2. Rough play is not permitted.
3. Use only the storage area assigned to your class.
4. Throwing or spraying snow is not permitted.
5. Tripping is not allowed.
6. Valuables should not be brought to the pond.
7. Pony Tail holders should be elastic.
8. Holding hands is not allowed.

SKATING WILL BEGIN ON JANUARY 27th.

On the first skating day the weather was wet; consequently, there was some doubt as to whether there would be skating. Only twenty children had brought their skates to school. The children had a lot of fun, but decided they

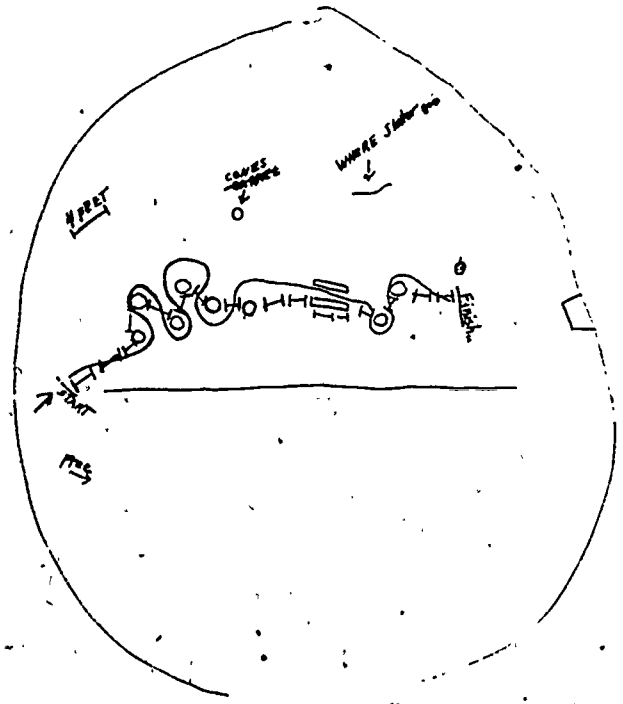


Figure C4-2

could have even more fun if they built an ice skating obstacle course. Indoors, they drew diagrams of what their obstacle course might look like, estimating where various obstacles might go. Figure C4-2 shows one child's sketch. Unfortunately, these children did not get beyond the planning stages. The weather permitted only one month of skating.

At the end of February, the ice skating had to be stopped due to the warm weather. The class felt it had been a success and was appreciated by both the supervising teachers and the skaters because there had not been one incident of misbehavior.

While the outdoor sports group had been working, the other two groups had investigated the use of the gym for indoor active games and the auditorium for a game room. The gym group obtained permission from the gym teacher to use the gym during the lunch period. Without polling the other intermediate classes, the group arranged a schedule that was convenient for our class and the fifth-grade class with which our class occasionally teamed. After a few days in the gym, however, other intermediate classes began to complain. The gym schedule was revised to accommodate all interested classes, but this was soon abandoned because there were too many interested children and the schedule became confusing and pointless.*

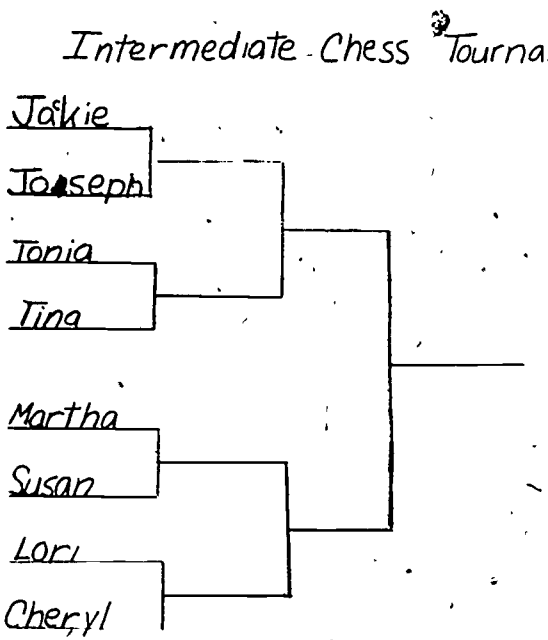
The games room group also faced an insurmountable scheduling problem because the room to be used also served as an auditorium. Because school plays, chorus concerts, etc., were scheduled for the spring, various groups needed to use the auditorium to practice. The group examined the auditorium schedule and agreed that there were not enough open time slots for them to proceed. The group resigned itself to the fact that the class would have to continue playing the board games in the classroom.**

The class discussed ways to make the board games more exciting. By hand vote it was determined that the game of chess was the favorite. Several children suggested having chess tournaments, and this idea was promptly accepted.

Most of the children decided to make their own chess

*The children might discuss the difficulties with the scheduling system and suggest improvements that could then be tried out.--ED.

**The class might discuss whether they could design some active games which would involve everyone in the class and could be played on some days. The class might also investigate whether another room might be used as a game room. --ED.



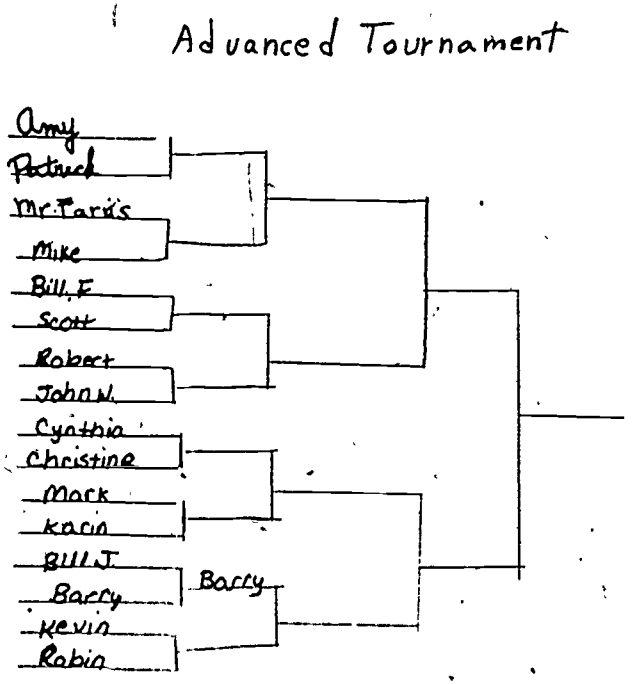


Figure C4-3

boards and pieces. Tri-Wall was cut up for the boards and wooden dowels were cut into one- and two-inch lengths for the chess pieces. The class was divided into two levels according to ability--advanced and intermediate. Within these two levels, players were matched according to relative ability. The two class tournament rosters are shown in Figure C4-3.

By March the weather permitted a few days of outdoor recess. The children recognized that the problem of what to do during noon recess time was still present. They began thinking about spring activities that could be offered and the general consensus was that softball was one good possibility. They spent several weeks surveying the intermediate grades to determine interest and number of possible players. They decided to have two leagues (boys and girls), and teams were arranged according to playing ability. Three categories of teams were arranged, fourth-grade boys, fifth/sixth-grade boys and fourth/fifth/sixth-grade girls. Teachers were also asked to participate.

The spring softball was another successful activity. During previous years the school faculty and administration, as well as the P.T.A., had been concerned over the ever-increasing numbers of playground accidents. This spring, however, the faculty and administration noted that there were fewer accidents, and the consensus was that this was because most of the children were involved with the softball games, either playing or watching.

5. LOG ON USING FREE TIME

by Elizabeth Gilpatrick*
Heatherwood School, Grade 6
Boulder, Colorado
(February 1974-May 1974)

ABSTRACT

This sixth-grade class spent approximately two and one-half hours per week establishing a music center in school where students could go to study or listen to music whenever they had available time. After much initial discussion of the problems of setting up a center, the class divided into groups to work on the following problems:

1. *Where to locate the center*
2. *How to equip it*
3. *Who should use the center*
4. *What the center rules should be*
5. *What music should be available in the center*

Because there was not much time left in the school year, the class decided to run a pilot program for a random sample of students using currently available cassette equipment. By doing this they would find out how large the center would have to be for use by the whole school and what problems might be encountered. They decided which records to tape by tallying suggestions gathered from each grade and choosing albums by the most popular performers. A tape recorder with seven earphones was set up on a modified study carrel in a seminar room, and the equipment was tested. When the center was ready, a girl and a boy from each class in the school were trained to use the equipment and allowed to use the center at certain times. After a month, the class discussed the problems they had noticed when the center was being used. Since, at that time, there were only two weeks left in the school year, the students decided to let each class in the upper grades use the music center for one day before the summer vacation.

My class became interested in setting up a music center in the school following a discussion on a challenge related to using music to improve the school environment. The gist

*Edited by USMES staff

of the discussion was that although background music might be pleasant for everyone, not everyone would have the same taste in music. The music center was seen as a feasible and practical solution to this problem. With a center, children could go to study, read, or listen whenever they had time during the school day without disrupting other students.

The class quickly identified many problems in organizing the center. As the children debated various issues, we listed on the board the following issues and tasks that needed to be considered and investigated:

1. Where to locate the center.
2. Who will use the center?
3. Care of the equipment.
4. Cost of establishing and maintaining the center.
5. Locating funds to finance the center.
6. Size of the center.
7. Number of people who can use the center at the same time.
8. Amount of time per person in the center.
9. Center hours.
10. Kind of music available.
11. Should duplicate tapes be available?
12. Who should run the center?

The class spent considerable time debating who should be able to use the center once it was established. Many children wanted the center to be just for the sixth grade; others felt we did not have the right to use school equipment exclusively for a few people. One main concern was that younger students might mistreat or mishandle the equipment, but some students felt that we could not be sure of this until we had allowed the younger children to use the center. Several students suggested initially allowing only our class to use the center. However, this idea was vetoed because everyone in the class knew that we were setting the center up only on an experimental basis and would be especially careful with the equipment.

One child suggested observing another class using the center. If the students mistreated the equipment, that class would not be allowed to use the center again. In the end, the children agreed to the idea of selecting, at random, several children from various grade levels to use the center initially.

At our next session we started to form committees that would be responsible for the main jobs in establishing the

center. Someone commented that he hated committees and suggested that the whole class work on each of the problems, one at a time. This idea was roundly criticized by those impatient with what had amounted, so far, to just too much discussion. They were vehement that five jobs could be done at once if we had five groups working simultaneously.

The major tasks were defined as follows:

1. Securing a desirable location for the center
2. Securing the proper equipment (we had decided a cassette tape recorder was the best financially) and storage
3. Establishing rules and regulations for the center
4. Setting up the sample who would use the center (talking to the kids' teachers, working out an initial time schedule, selecting children)
5. Selecting the music to be taped

We were stuck for a while on how to choose the members of each committee, until a student suggested we just try a show of hands and see whether the groups were fairly even in number of members. (Luckily there were!) The newly formed committees then elected chairmen and started to work on their problems.

The [redacted]s worked in these five groups and occasionally held joint meetings when problems overlapped the different areas. Although the groups worked simultaneously the activities of each group are described in turn.

The children in the location group immediately went to talk to the librarian about the possibility of situating the listening center in the library. While the librarian was in favor of the idea, he offered the children a rather unsuitable spot (being too small and hard to reach). However, the children's main concern was that the librarian insisted that students using the music center would have to follow the library rules if the center were located in the library. This worried the children because they wanted to devise their own rules for the center. They decided to set up the center elsewhere so that they could have control over it in the testing stages. They thought that when it was running smoothly, they might relocate it to the library so that the librarian could monitor it. This course of action also had the advantage of getting library funds for equipment for the fully operational center.

They next talked with the principal and secured permission to use a seminar room for a couple of hours, three days a week. After again discussing the situation with the

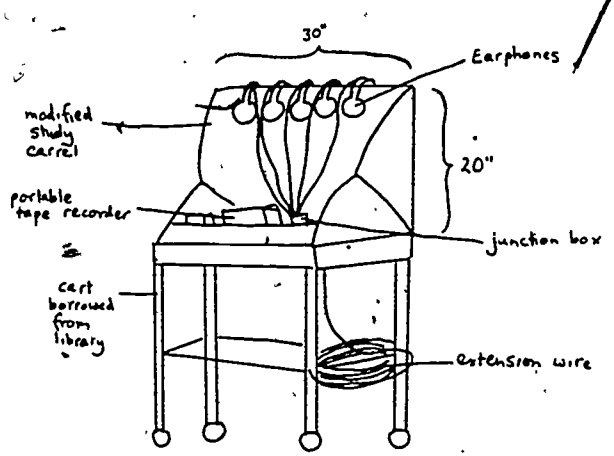


Figure C5-1

librarian, they decided to set up the trial listening center in the seminar room.

The equipment group got off to a slow start as they had difficulty selecting a chairman. When, after several sessions, they still had found no means of getting equipment for the test center, I helped them by borrowing a portable cassette recorder from another teacher. The students still had to find earphones, a junction box, tapes, etc. There were several possibilities for long-term funding of the center, including submitting a proposal for P.T.A. support and library resources if we went under the librarian's rather over-protective wing. For our immediate needs, the library funds (supplemented by my own pocket) provided money for tapes. The equipment group decided to buy sixteen tapes initially. The library was also their source of earphones and terminals. The earphones were connected to a junction box that was plugged into the cassette recorder.

The equipment group also saw to the physical setup of the center. They made sure tables would be available and considered whether to design a listening carrel of some sort. They obtained a cardboard study carrel that they modified by cutting some holes in it to suit the needs of the listening center. This is illustrated in Figure C5-1.

The boys in the equipment group worked out a good layout for all the equipment in the seminar room and tested the equipment to be sure it was in good working order. Unfortunately, they left the tape recorder and earphones in the seminar room, and someone spilled something powdery all over it. They were very upset about this, but it precipitated much thought about places to store the equipment when it was not in use. They talked about locking it up but decided that the equipment needed to be available during the day and that there was no problem at night. The media room, the office, and the quiet room were possible locations they suggested. Their criteria for a storage room were the following:

1. ~~not~~ in someone else's way
2. supervision
3. easy access
4. easy to get out and use

They decided they needed a cart on which to store the equipment and asked the librarian if they could have a cart and if they could keep the equipment in the media room. Both these requests were granted, and they cleaned up the

equipment and stored it in its new home.

After completing the task of securing the seminar room as the location for the listening center, the members of the location group joined forces with the rules and sampling groups to develop procedures for testing the center. The sampling group first found out from the office what the proportion of boys to girls and upper to lower elementary children was in the school. They wanted to know this to be sure of getting a representative sample of the whole school. As it turned out there were approximately fifty-one per cent boys and forty-nine per cent girls, and so the children decided that one boy and one girl from each class would be a representative sample. They chose their sample by randomly pointing a finger at names on each class list. They wrote up a list of all these names and distributed it to the teachers. The sheets also contained information about when the center would be open.

The rules group began immediately to decide what kinds of behavioral and scheduling rules they thought feasible to test. However, after drawing up some fairly practical rules, they decided they could go no further until the scheduling of the room and the sampling of the school had been organized. Although this group was very keen on writing notes and making signs, they readily admitted that they themselves did not read signs carefully. Thus, they decided that the best method to use would be to train the children personally; when everything was ready, they would have a mass meeting of all the children selected for the test. They would tell them what we were testing, show them the center, acquaint them with the schedule, explain the equipment, and make sure the primary children understood everything.

The rules group then got into a discussion of how many children would be allowed to use the center at any one time, how long they would be allowed to stay, and what to do about people who misused the center. Various suggestions for monitoring the center were made, such as to have children sign their name and the time as they entered the room, to have someone in the room all the time, and to have children sign out with their teacher when they wanted to use the center.

This last idea was most popular since they could check the teachers' charts if someone misused the equipment at any time. To simplify this process, they decided to make charts for each teacher. Two boys volunteered to do this and to distribute the charts to the teachers before the center opened.

We discovered that we had twelve terminals and only seven earphones and discussed what to do if there were more than seven people or if the children fought over what to listen to. We also discussed how long each child should be allowed to listen. They felt that one whole side of a tape (forty-three minutes) was too long but that only one song (about two minutes) was too short. The rules they eventually drew up were as follows:

1. People who mishandle equipment more than once should not be allowed to use the center again.
2. No more children should use the center than there are earphones available.
3. No tapes are to be borrowed from the center.
4. After listening for thirty minutes, children who have been in the center the longest should give up their places to others coming in.
5. The choice of music is on a "first come, first served" basis but should be relinquished after thirty minutes.

The group thought they should set up a schedule for the children in the class to monitor the use of the center. The monitoring schedule and the schedule of children responsible for the equipment were drawn up in chart form as soon as the seminar room schedule was finished.

The music selection group spent the first session realizing how difficult their task was. They discovered how varied their own musical tastes were and realized that the first graders might not like performers such as Alice Cooper, which the music selection group themselves enjoyed. In the next session they hastily devised a survey to give to all six graders to get some indication of their preferences for different types of music. The form they prepared listed different categories of music, and the children were to mark the ones they liked:

orchestra
jazz
rock
pop
solo
country
comedy
folk

They discussed their survey further and realized that lower elementary children would have diffculty reading or even understanding some of the categories. One girl suggested asking the primary teachers whether their students would understand the words on the list. After talking further about these categories, they found that even some members of the group were not clear about the meanings of the categories. They tried cutting it to fewer and simpler categories but that did not seem very satisfactory.

The next suggestion was to have everyone list five records or songs that they liked and put them in a box. This seemed likely to produce an overwhelming response, and, when someone thought of having a suggestion box, all the group agreed this was a good idea. They thought that they could categorize the suggestions into different types of music and choose the records accordingly.

The children made a ballot box for each grade level and decorated them with musical symbols. They wrote and scheduled an all-school announcement explaining why the suggestions were wanted and stating that the boxes would be left out for a week.

When it came to collecting the suggestion boxes, the group was disappointed to find that first graders had cut up their box and were using it for bottle caps. Although the first graders were given another box, they had lost interest in answering the survey. The group was very excited, however, about opening the other boxes and reading the suggestions. They were very partisan and cheered or groaned at "good" or "bad" suggestions. There was a lot of confusion as to how to count the suggestions. They finally began to write down each suggestion and make a tally mark each time it was suggested. The group working with the fourth-grade box began to throw out some of the responses and had to be reminded that all suggestions had to be tallied, even if they were considered "dumb."

They had some trouble interpreting the survey results because some responses indicated song titles, while others gave performers' names, and still others gave album titles. We decided that the only possible way to categorize was by performers and listed the most popular performers for each grade level. It turned out that lower elementary students were interested in music they had heard in music class and on television programs such as "Sesame Street." Upper elementary students were interested in popular music they had heard on the radio and some classical music they had heard in music class or performed themselves in choirs and instrumental groups.

When the records were finally chosen, the students started bringing them from home. As I was the only person with equipment to tape the records, this became my Easter vacation assignment. Most of the tapes were of pop records, but we made two tapes of Sesame Street songs, a children's album by Peter, Paul, and Mary, and another album of songs for children. There were also some classical records that the children knew well, mostly examples of the orchestral instruments they studied. When we had fourteen tapes recorded, we decided we were ready to open the center.

The opening of the listening center was delayed a couple of weeks because both the class and myself were very involved in rehearsing for an after-school musical performance. However, when we finally had the time to train the children in the sample, we opened the center and let it run for several weeks. Then we all came together to discuss what we had accomplished and what the problems were.

The main problem seemed to have been that some of the children in the sample did not use the listening center and that some of the children in the class forgot the schedule for taking equipment to the seminar room and monitoring the center. I pointed out that this was their responsibility and that they could not expect teachers to remind them. One girl thought that if the school bought a lot of new equipment children would be more interested in the center. We also had a problem of some mistreatment of the equipment, and I had to go into the room a few times at the request of the monitors to enforce correct use of the equipment.*

We then discussed what we should do with the center in the remaining two weeks of school. About half the class was in favor of closing it because they were too busy with sports and other special events to care for it. One child suggested reserving it for upper grades. After a long discussion about various ways to keep the center open, fifteen

*If more time was available the students might (1)design a questionnaire to find out why the children did not use the center, (2)analyze the data to find out the ages of the children that used the listening center more often, (3)set up a better system for managing the listening center, (4) find out the grade levels of children who mishandled the equipment, and (5)find out which tapes were used more frequently.--ED.

children voted to keep it open and ten voted to close it. These ten left the group to do something else.

Because they had not yet used it themselves, one of the remaining children suggested arranging a special time for the class to use the center. This developed into the idea of letting each class in the upper grades use the center for one day. Several students wanted to encourage the fifth graders to use it to generate an interest in continuing the center next year when the present sixth graders had left.* However, the group decided to start with the sixth graders, allowing children who had finished their work and had permission from their teachers to use the center. After checking with the sixth-grade teachers, the children arranged a schedule so that each sixth-grade class could use the center for a day.

The lasting effect of the children's work on this challenge was the purchase of an audiovisual complex for the school. As our efforts at a listening center had proved fruitful, the faculty thought that money left over from the school's original building fund might be made available for equipment.

The six boys on the equipment committee accompanied me one Saturday to a local sound equipment store in order to decide which equipment should be purchased. We spent the whole morning there, and the assistant was excited by our project and was very helpful. He demonstrated many different models, explaining the advantages of each, and the children considered whether grade school students could operate the equipment.

On the basis of this field trip, we could recommend definite brands to the faculty. Unfortunately, the proposal to the faculty had to be written very quickly, and there was insufficient time to let the children themselves write it. But, the result of our efforts was that $800 from the building fund, supplemented by another $165 from the P.T.A., was spent on audiovisual equipment. As the delivery of the equipment took nearly a year, this class could do no more toward a permanent school listening center.

*The class could have written instructions, based on their experiences and the results of the evaluation of the test run, for the next grade to set up the listening center for the whole school.--ED.

6. MINI-LOG ON USING FREE TIME
Designing Dice Replacements

by Michael Kingston*
Prairie School, Grade 5
Urbana, Illinois
December 1975

ABSTRACT

When this fifth-grade class began work on designing replacements for dice, they investigated many different possibilities including spinners, coins, a number board, marbles rolled into holes in a box, and drawing numbers from a hat. While a control group threw dice and recorded how many times each number (from 2 through 12) came up on a bar graph, other groups constructed their devices and then tested them in a similar manner. By comparing the graphs for the various devices with the dice graph, the class was able to decide which devices would work as replacements for the dice.

My fifth-grade class began work on designing replacement dice for a Monopoly game after I told a story about an occasion on which dice were needed but regular dice were not available.** Class discussion produced many ideas, including the following:

1. make dice
2. use baby blocks
3. a spinner
4. a number star
5. roll marbles into holes in a cardboard box
6. flip coins
7. throw an eraser on the board and move to the square it hits
8. drop a piece of paper on a number board
9. put numbers under cups
10. draw numbers from a hat

At this point, one student objected to many of the suggestions, "A lot of those things won't work because the numbers won't come up the way they do on the dice." Many of the other students disagreed with this statement, and pointed out reasons that their ideas would work like the dice.

*Edited by USMES staff

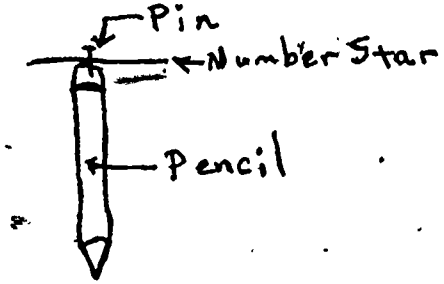
**The challenge to design dice might be more real if special dice or spinners were needed for a game.--ED.

Finally I asked, "How could you prove that the numbers would come up one way for the dice and another way for some other method?" One girl then suggested that the dice could be rolled and then the other method could be tried to see if the same number came up on both.

Another student modified the idea: "Write down all the numbers when they come up and then see if your two lists are the same." The class decided to divide into groups to test each replacement method listed, with one group rolling dice and recording numbers to be compared with the other methods.

At our next session the groups testing various methods wrote up descriptions of their dice replacement devices, including a list of materials needed and a drawing of anything that had to be built. (See Figures C6-1 and C6-2 for sample drawings.)

④ A Number Star - Construction paper, straight pin, pencil



Spin the star and move that many spaces.

Figure C6-1

⑤ Drop a piece of paper on a number board.

Construction Paper

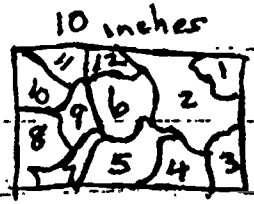


Figure C6-2

The Dice Group began rolling dice and recording the numbers that came up. Near the end of the session, the Dice Group showed me a piece of paper covered with columns of numbers. One of the students said, "This doesn't make any sense." When I pointed out that the data looked good but that it was hard to understand because of the way it had been recorded, one student suggested counting how many times each number had been recorded and writing that down.

The next day I showed the chart made by the Dice Group to the rest of the class. I asked the class "How many sixes did the Dice Group get? How many zeroes? How many ones? How many nines?...Elevens?" The class saw that the Dice Group didn't get any zeroes or ones and that there were more sixes rolled than elevens. I then asked the class, "What numbers can you get when you roll two dice?" The children then realized that the dice replacement devices they were constructing should only display numbers 2 through 12, since these were the only numbers that came up when the dice were thrown.

I next showed the class how to make a bar graph tally of their results. After giving each student a piece of graph paper, I set up a graph form on the board and, as one student rolled the dice, recorded the results on the graph. As the students observed the process, they began to generalize what was happening with statements such as "It is higher in the middle and lower at the ends." After fifty rolls, I ended the session by reminding the class of these two points:

- Make sure your projects give all the numbers from 2 to 12.
- Record your test results on graph paper.

Most of the groups continued to work on constructing a dice replacement device. Some students went to the Design Lab to use the tools and materials available there.

The Dice Group rolled dice up to 500 times and then began constructing a large graph to display their data. One student in the Dice Group was concerned about comparing results that were tested for different numbers of trials. He wondered how to compare 100 spins of the number star with 500 rolls of the dice. When I suggested that this could be done by calculating percentages, I found that the whole group was interested in learning how to do this. After referring to a math text, I showed the group how to calculate percentages. The Dice Group then calculated the percentage of throws recorded for each number appearing on their graph.

As the other groups worked on their devices, I noticed that several modifications were made:

1. Students working on the number star constructed a second star numbered 7 thru 12, then pinned the two stars to a pencil eraser so that all twelve points were visible.

2. Students constructing the number board erased the area for the number one.
3. Students drawing numbers from a hat threw out the slip for number 1 and added slips for numbers 7 thru 12.
4. Students putting numbers under cups added cups for numbers 7 thru 12.

By the next session, most students had completed construction and were testing their devices. The question came up as to the number of trials necessary for a good test. The Dice Group noted that although more trials had made their graph higher, the shape of the graph at the top had not changed much. They felt that the shape of this curve was more important than the number of trials. However, they made no decision as to how many trials were enough.

Because many students continued to ask how many trials were enough, I called the class together and displayed several student graphs, suggesting that their shape at the top was the most important thing rather than how "high" the graph was. When several students still requested a specific number of trials, I arbitrarily selected 100 as the minimum number of trials.

Several groups were having difficulties. The Coin Flipping Group could not decide how to eliminate one and zero from their flips but finally decided to ignore flips which gave zero or one and flip again.

The Spinner Group decided that their project was no good since they didn't put all the right numbers on the spinner and there was not enough time to make a new spinner. I pointed out that to play Monopoly, *two* dice must be rolled and the numbers added to get the correct number of spaces to move. I then asked the group how they could use the spinner in playing Monopoly. The group then saw that if they used the spinner twice for each turn and added the numbers, they could make the spinner have the same numbers as those on the dice.

As the groups completed their testing, two groups expressed dissatisfaction with their very flat graphs but felt that changing their projects would be cheating. I pointed out that it would not be cheating to modify their projects and that the important thing was that they had carefully tested their devices and proved that they did not work. Since both groups (Pulling Numbers from a Hat and Numbers under Cups) now wished to modify their devices, I demonstrated with a pair of dice (a red die and a white die) why certain numbers came up more often than others.*

As I threw the dice, students constructed a chart similar to the chart below:

Number	Combination	Total
1		0
2	1+1	1
3	1+2 2+1	2
4	1+3 2+2 3+1	3
5	1+4 2+3 3+2 4+1	4
6	1+5 2+4 3+3 4+2 5+1	5
7	1+6 2+5 3+4 4+3 5+2 6+1	6
8	2+6 3+5 4+4 5+3 6+2	5
9	3+6 4+5 5+4 6+3	4
10	4+6 5+5 6+4	3
11	5+6 6+5	2
12	6+6	1

I then pointed out that since there were five possible ways to roll a six with the two dice, they needed five possible chances to pull a six out of the hat or to get a six by turning over the cups. The Pulling Numbers from a Hat Group made new numbers in the proportions listed in the chart; the Numbers under Cups Group saw that they would need thirty-six cups (which would be quite cumbersome) and decided not to modify their project.

*If only one die is used, each number would have an equal chance of coming up. Therefore, the bar graph would be flat on top.--ED.

When the groups finished testing, they compared their results with the graph of the Dice Group. Many groups had trouble with this comparison until I drew up a transparency of the Dice Group's graph. Each group then laid the transparency over their experimental graph, adjusting the sheets to get the curves to match as closely as possible. Some graphs did not match at all, others were close but none matched exactly. When the question was raised as to how close was close enough, one student suggested that if the two curves were everywhere within two graph paper squares of each other, then that was close enough. After some discussion everyone in the class decided to accept the two-square standard.

At our final session, each group prepared a report of their findings and the class reached the following conclusions:

1. The home-made dice worked fine.
2. Baby blocks made good dice.
3. A spinner can be used if it is numbered 1 to 6 and spun twice for each move.
4. A number star makes all the numbers come up an equal number of times. It cannot be used for dice.
5. Rolling two marbles into holes numbered 1 to 6 works fine.
6. Flipping 12 pennies works okay but zero and one are a problem which isn't really solved yet.
7. Dropping an eraser on the Monopoly board was not well tested as the students spent all the available time constructing the board and showed little interest in testing the hypothesis.
8. Dropping paper on a number board didn't work because it gave an irregular graph. Student said it could be made to work by making the space for each number larger or smaller.
9. Numbers under cups could be made to work but it would be bulky and hard to use.
10. Drawing numbers from a hat works when the number slips are in the correct proportion.

With the presentation of these reports, our work came to an end. The consensus of the class was that they had learned a great deal about proposing and testing ideas.

All enjoyed working on the unit very much.

7. MINI-LOG ON USING FREE TIME
Testing the Fairness of A Coin

by Cathy Daane
Northwestern School, Grade 5
Eaton Rapids, Michigan
April-May 1972

ABSTRACT

When some children in this fifth-grade class commented that one side of a penny was "lucky," the teacher showed the class how to keep track of many coin flips on a data chart. The children then spent several class sessions flipping pennies and recording their results. At the end of each session the class discussed the significance of the data. After several sessions, the teacher made a histogram of the students' data. When the class finished their coin flipping experiment, some children felt that ten out of twenty heads was the most likely result, but others were not convinced.

After my class had worked on designing a fair game for two children using a penny as a die, several children stated that one side of the penny was "lucky." When I asked them which side was more likely to turn up when the penny was flipped, some said heads and some said tails. After demonstrating how to keep track of flips on a data chart, I asked each child to flip his or her penny ten times and record the results to see whether one side of the coin did indeed turn up more often.* When the class had completed the ten trials, I recorded the following results on the board:

Number of Heads (10 flips)	Number of people who had this result
0	0
1	1
2	3
3	4
4	2
5	5

*The children might be interested in one particular coin, especially if it looks worn or bent. Each could toss the coin ten times and they could compare the results.--ED.

Number of Heads (10-flips)	Number of people who had this result
6	4
7	1
8	1
9	0
10	0

After examining the results, the class concluded that five heads out of ten flips was the most frequent result, but they didn't know why it had turned out this way. I then asked what they would predict about twenty flips of a penny. Most of the class agreed that ten heads would be the most frequent result.

At our next session we talked about the lucky side of the penny again. Some of the children still felt that one side was lucky; all wanted to flip the pennies again to see what the results would be. Before we began flipping, we talked about various ways of tossing the coin to make either heads or tails come up and how we should be careful to flip the coins in a fair way. As the children began to flip their pennies and tally the results, I watched to see how they were tossing the coins. Everyone seemed to be tossing fairly.

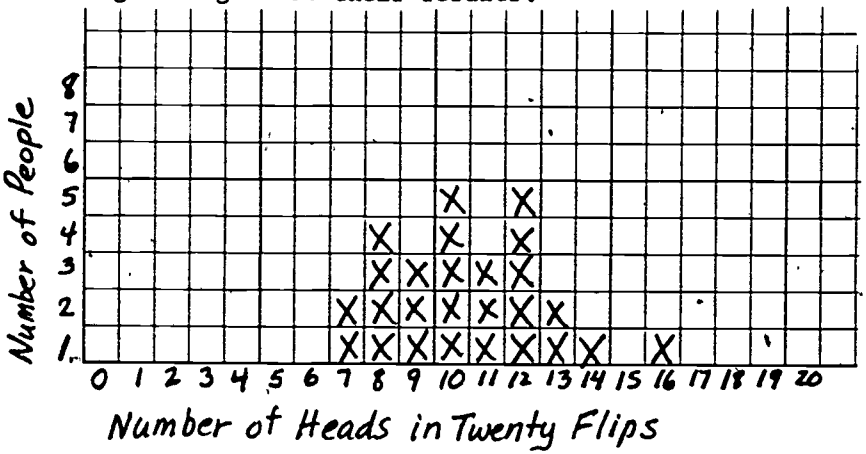
Again, we recorded the results on the board:

Number of Heads (10 flips)	Number of people who had this result
0	0
1	0
2	2
3	1
4	6
5	5
6	6
7	4
8	2
9	0
10	0

This time the results were not like the previous trial because the most frequent results were either four heads or

six heads out of ten tosses. I asked the class how they would bet if they were given five dollars and had to predict how many heads would come up in ten tosses. The children's answers were evenly spread among four heads, five heads, and six heads.

We decided to experiment further with the coins, this time recording the results of twenty flips of the penny. Instead of putting a data chart on the board, I made the following histogram of their results:



The children saw that ten heads and twelve heads were the most frequent results. Some children felt that ten heads was the most likely result, but others were not convinced. When I asked the class to predict what would happen if we did twenty more flips and added them to the graph, some responded that the graph would have more data in the center, others that the data would be more spread out. One student commented that if the penny were flipped enough times, the most likely result would be an equal number of heads and tails. Therefore, neither side was a lucky side.

D. References

1. LIST OF "HOW TO" CARDS

Below are listed the current "How To" Card titles that students working on the Using Free Time 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 9 How to Make a Conversion Graph to Use in Changing Measurements in 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

*Presently called Slope Diagram.

New titles to be added:

How to Record Data
How to Round Off Data
How to Compare Two Sets of Data by Making a Q-Q Graph
How to Design and Analyze a Survey
How to Choose a Sample
How to Compare Two Sets of Data by Using Interquartile Ranges
How to Find Out Things by Measuring

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.

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 Using Free Time. 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

DP13 People and Space by Gorman Gilbert

GEOMETRY AND SHAPES

G 1 Making Polyhedra by Alan Holden
G 2 Solids Made of Equilateral Triangles by Alan Holden
G 3 The Five Regular Solids by Alan Holden
G 4 Semi-Regular Solids by Alan Holden
G 5 "Fair" and "Regular" Polyhedra by Earle Lomon
G 6 Mass Production of Equilateral Triangles and Squares by Louise Buckner and Frank O'Brien

GRAPHING

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

GROUP DYNAMICS

GD 2 A Voting Procedure Comparison That May Arise in USMES Activities by Earle Lomon

MEASUREMENT

M 3 Determining the Best Instrument to Use for a Certain Measurement by USMES Staff

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
PS 5 Examining One and Two Sets of Data Part I: A General Strategy and One-Sample Methods by Lorraine Denby and James Landwehr
PS 6 Examining One and Two Sets of Data Part II: A Graphical Method for Comparing Two Samples by Lorraine Denby and James Landwehr

RATIOS, PROPORTIONS, AND SCALING

R 1 Graphic Comparison of Fractions by Merrill Goldberg
R 2 Geometric Comparison of Ratios by Earle Lomon
R 3 Making and Using a Scale Drawing by Earle Lomon

3. BIBLIOGRAPHY OF NON-USMES MATERIALS

The following books are references that may be of some use during work on Using Free Time. The teacher is advised to check directly with the publisher regarding current prices. A list of references on general mathematics and science topics can be found in the *USMES Guide*.

A. Games and Game Design

Culin, Stewart. *Games of The North American Indians*. New York: Dover Publications, Inc., 1976.
Games of every variety played by the Indians of North America. Instructions and illustrations of the equipment used are provided. Types of games include dice games, dexterity games, and racing games. For children or adults.

Faulkner, Edward. *Games, Ancient and Oriental and How to Play Them*. New York: Dover Publications, Inc., 1961.
Instructions and layouts of board games from Egypt, Burma, and many other places. For children and adults.

Goren, Charles H. *Goren's Hoyle Encyclopedia of Games*. New York: Hawthorn Books, Inc., 1950; 1961.
Directions and layouts for a large variety of games. For children and adults.

B. Using Devices as Dice Replacements

Holden, Alan. *Shapes, Space and Symmetry*. New York: Columbia University Press, 1971.
An examination of the regular polyhedra and their structure. Illustrated with models made by the author. Useful when constructing replacements for dice. For children and adults.

Walter, Marion. *Boxes, Squares and Other Things*. Washington, D.C.: National Council of Teachers of Mathematics, Inc., 1970.
A booklet investigating cubes and the various arrangements of squares that can be folded into a cube. The ideas presented may be useful background information when investigating replacements for dice. For teachers.

Wenninger, Magnus J. *Polyhedron Models for the Classroom*. Washington, D.C.: National Council of Teachers of Mathematics, Inc., 1966.
Background information and instructions for constructing many different types of polyhedra. For teachers.

C. Organizing Centers, Constructing Furniture

Biggs, Edith E., and MacLean, James. *Freedom to Learn: An Active Learning Approach to Mathematics*. Ontario, Canada: Addison Wesley Ltd., 1969.
Chapter 3 provides advice and plans for arranging and storing materials as well as a useful list of inexpensive materials and equipment for the classroom. There is also a section on games and puzzles and, in section 8.3, a discussion of coin and dice tossing with graphic illustrations of data. For teachers.

Early Childhood Education Study. *Building With Tubes* and *Building With Cardboard*. Newton, Education Development Center, 1970. (Order from Education Development Center, 55 Chapel Street, Newton, Mass. 02160.)
These two pamphlets contain many patterns for furniture and storage containers made from tubes and cardboard, as well as helpful hints for working with these materials. For children and adults.

Farallones Designs. *Farallones Scrapbook*. Berkeley: The Boys in the Back, 1971. (Order from Farallones Designs, Star Route, Point Reyes Station, California 94956.)
A resource book for teachers. Chapters on changing classrooms and on sources of recycled materials are most useful.

Wastnedge, E.D., ed. Nuffield Junior Science *Teacher's Guide 1*. New York: Agathon Press, Inc., 1967.
The chapter on classroom organization can be used for ideas when organizing an art or music center as well as when rearranging the classroom to allow the best use of free time within a limited space. For teachers.

Workshop for Learning Things. *Further Adventures of Cardboard Carpentry*. Watertown: Workshop for Learning Things, 1972. (Order from Workshop for Learning Things, 5 Bridge Street, Watertown, Mass., 02130.)
Drawings and photographs accompany plans and building techniques for making Tri-Wall furniture. For children and adults.

D. Arts and Crafts

The Children's Museum, Resource Center. *Recycle Notes*. (Order from The Children's Museum, The Jamaica Way, Boston, Mass., 02172.)
An illustrated booklet with many ideas and instructions

on how to use recycled materials for education and crafts projects. Among the ideas presented are various games, masks, weaving looms, simple musical instruments, and ways to print. For children and adults.

Mattil, Edward. *Meaning in Crafts*. Englewood Cliffs: Prentice Hall, Inc., 1959.
An excellent comprehensive crafts book. For teachers.

Wiseman, Ann. *Making Things: The Handbook of Creative Discovery*. Boston: Little, Brown and Company, 1973.
A variety of simple arts and crafts ideas with directions that children can easily follow. For children and adults.

4. GLOSSARY

The following definitions may be helpful to a teacher whose class is investigating a Using Free Time 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 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.

Audio — Relating to the transmission, reception, or reproduction of sound.

Audiovisual — Relating to both hearing and sight.

Audiometer — An instrument for measuring hearing ability.

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.

Congruent — Having the same size and shape. Congruent figures fit exactly when one is placed on top of another.

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.

Corner (Vertex) — The point on a polygon where two sides intersect; the point on a polyhedron where three or more faces meet.

Correlation — A relationship between two sets of data.

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

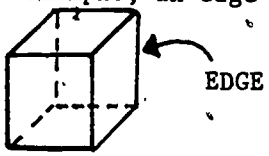
Data — Any facts, quantitative information, or statistics.

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.

Edge — The straight line formed by the intersection of two faces of a polyhedron. For example, an edge of a cube is shown below.



Event — A happening; an occurrence; something that takes place. Example: the opening of the art center, or a group playing a game.

Face — One of the flat surfaces of a polyhedron. Each face is a polygon.

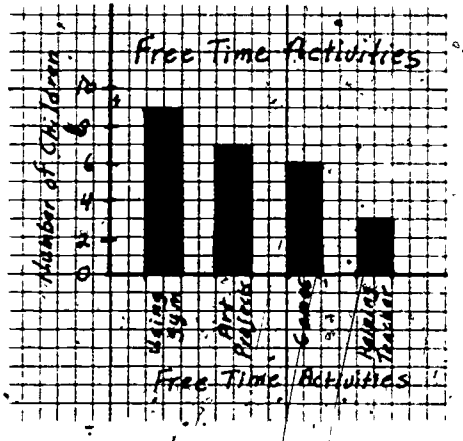
Frequency — The number of times a certain event occurs in a given unit of time or in a given total number of events.

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 in the class who prefer certain free time activities.

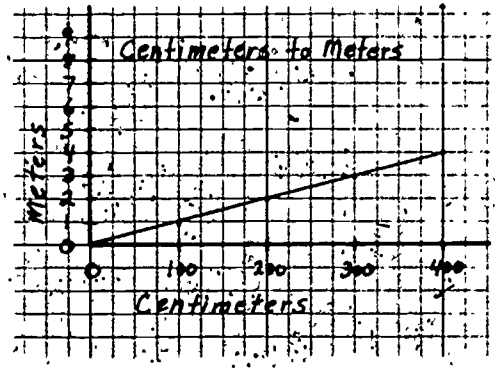
Free Time Activities	Number of Children
Using gym	9
Art Projects	7
Games	6
Helping teacher	3



Conversion Graph

A line graph that is used to change one unit of measurement to another. For example, changing centimeters to meters, and vice versa.

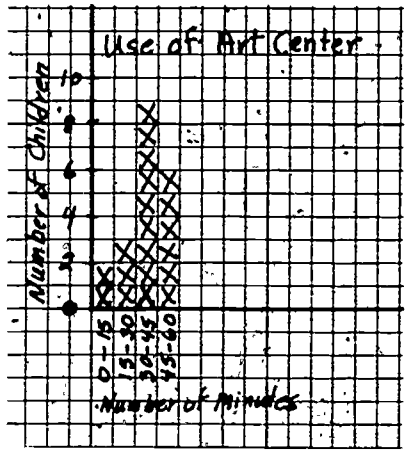
Centimeters	Meters
100	1
200	2
300	3
400	4



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 number of children using the art center for various lengths of time during the day.

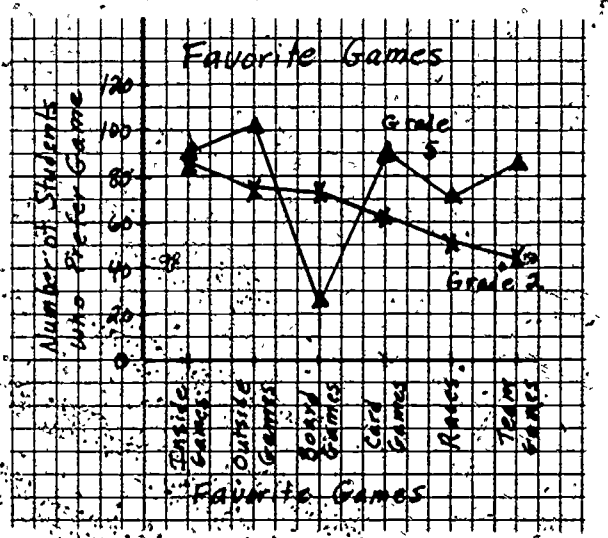
Number of Minutes	Number of Children
15	2
30	3
45	9
60	6



Line Chart

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. (See *Line Graph*.) This is a useful representation when two or more sets of data are shown on the same graph. Example: survey results on favorite games from grades 2 and 5.

Favorite Games	Number of Students Who Prefer Games	
	Grade 2 - X	Grade 5 - A
Inside Games	85	88
Outside Games	76	102
Board Games	73	28
Card Games	62	92
Races	51	72
Team Games	45	93



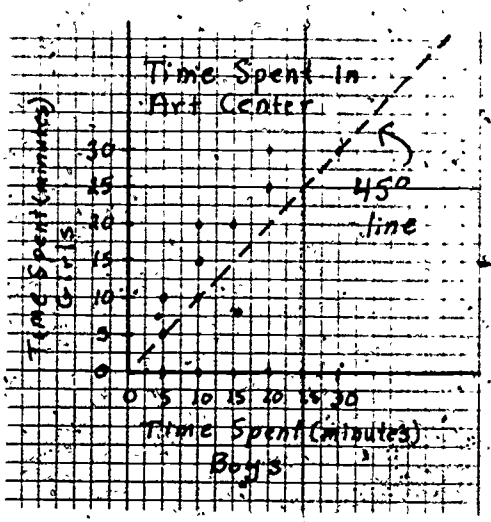
Line Graph

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 *Line Chart*).

Q-Q Graph

A graph that shows the comparison between the same type of data collected from two groups of people,...from two different situations,...from two brands of a product. Example: amounts of time spent in the art center by boys and by girls. The data for each set is ordered and the smallest measurement of one set plotted against the smallest of the other set, the second smallest against the second smallest, and so on. The scatter of points is compared to a reference line, a dashed 45° line that represents the data from two identical sets.

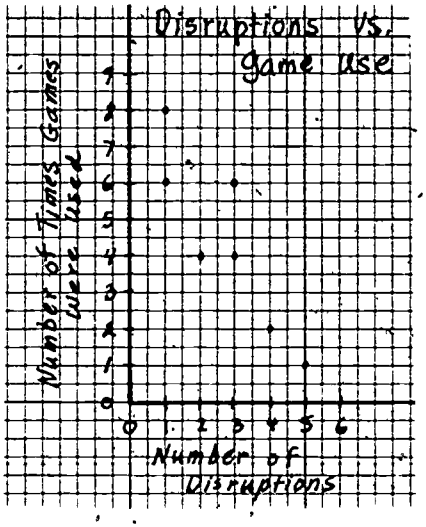
Time Spent (minutes)	
Boys	Girls
5	5
5	10
10	10
10	15
10	20
15	20
20	25
20	30
30	30



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 a student; the position of the point indicates the number of disruptions caused by the student in a week and the number of times the student used the games in a week.

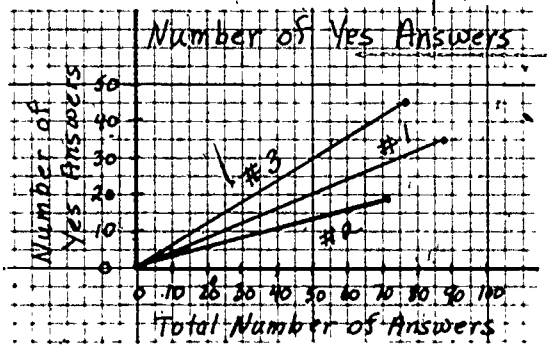
Student	Number of Disruptions	Number of Times Games were Used
A	1	6
B	1	8
C	2	4
D	3	4
E	3	6
F	4	2
G	5	1



*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 less steep the line, the smaller the ratio. For example, in the diagram showing the ratio of yes answers to total answers for different questions on an opinion survey, the ratio of yes answers to total answers for Question #3 is greater than that for Questions #1 and #2, and, therefore, Question #3 has the greatest percentage of yes answers.

Question	Number of Yes Answers	Total Number of Answers
#1	35	87
#2	19	71
#3	45	76



*Formerly called triangle diagram.

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.
Inventory	The quantity of goods or materials on hand.
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.
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.
Polygon	A closed two-dimensional figure bounded by straight lines. Examples: triangles, quadrilaterals, pentagons.
Regular Polygon	A polygon with all sides and angles equal. Examples: equilateral triangle, square, regular pentagon.
Polyhedron	A closed three-dimensional figure bounded by intersecting plane (flat) surfaces.
Regular Polyhedron	A polyhedron having all faces, edges, and corners alike. Each face is a regular polygon.
Regular Tetrahedron	A polyhedron having four identical faces, each of which is an equilateral triangle. Three triangles meet at each corner.
Cube	A regular polyhedron with six identical square faces. Three square faces meet at each corner.

Regular Octahedron	A polyhedron having eight identical faces, each of which is an equilateral triangle. Four triangles meet at each corner.
Regular Dodecahedron	A polyhedron having twelve identical pentagonal faces. Three pentagons meet at each corner.
Regular Icosahedron	A polyhedron having twenty identical faces, each of which is an equilateral triangle. Five triangles meet at each corner.
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.
Quartile	
First	The first quartile is the value of the quarter-way piece of data in an ordered set of data.
Third	The third quartile is the value of the three-quarter-way piece of data in an ordered set of data.
Interquartile Range	The range or length of the middle 50% of an ordered set of data; the difference between the first and third quartile.
Range	The difference between the smallest and 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 space (e.g., art center, music room) to the given area of the space might be 10 children/60 square meters or 10 children:60 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	The number of elements in a sample.
Scale	A direct proportion between two sets of dimensions (as between the dimensions in a drawing of a lab and the actual lab).
Scale Drawing	A drawing whose dimensions are in direct proportion to the object drawn.
Similar	Having the same shape but not necessarily the same size.
Slope Diagram	See *Graph*.
Sound Intensity	Level or loudness of a sound. A measure of how much sound energy flows through a given area in a given time. Measured in decibels or watts/cm^2.
Sound Level Meter	An instrument used to measure sound intensity.
Statistics	The science of drawing conclusions or making predictions using a collection of quantitative data.
Symmetry	The correspondence of parts of a figure on opposite sides of a point, line, or plane.
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: a tally of survey results on student preferences for different types of games.
Wholesale Price	The price level of goods sold in large quantity to a merchant for resale.

E. Skills, Processes, and Areas of Study Utilized in Using Free Time

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 Using Free Time 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 Using Free Time 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 Using Free Time 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 Using Free Time. 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 Using Free Time.

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.

	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--observing, surveying, researching, measuring, classifying, experimenting, constructing.	1
Asking questions, inferring.	1
Distinguishing fact from opinion, relevant from irrelevant data, reliable from unreliable sources.	1

	Overall Rating
Evaluating procedures used for data collection and analysis. Detecting flaws in process or errors in data.	1
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.	2
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

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

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

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

	Overall Rating
Process	
Observing/Describing/Classifying	2
Identifying Problems, Variables	1
Manipulating, Controlling Variables/ Experimenting	2
Inferring/Predicting/Formulating, Testing Hypotheses	2
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	3
Geography/Physical Environment	-
Political Science/Government Systems	3
Recent Local History	3
Social Psychology/Individual and Group Behavior	3
Sociology/Social Systems	2

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

Identifying and Defining Problems	• Students identify a need to do something that is fun and useful during their lunch period and other free time. • See also SOCIAL SCIENCE list: *Identifying Problems, Variables.*
Deciding on Information and Investigations Needed	• After a class discussion, students vote to investigate the possibility of setting up an arts and crafts center for free time use. • Students decide to investigate possible locations for the arts and crafts center. • Students decide to survey other classes to find out if they would like to use an arts and crafts center. • Students decide to interview principal and other school personnel to get information, advice, and permission for an arts and crafts center. • Students discuss equipment and supplies needed in arts and crafts center.
Determining What Needs to Be Done First, Setting Priorities	• Students decide they should first survey other classes, then interview principal and other school personnel so that they can present data to back up their ideas to the principal and other school personnel. • Students decide to walk around the school and check on possible locations before speaking with the principal so that they can present some suggested locations to him.
Deciding on Best Ways to Obtain Information Needed	• Students decide that conducting an opinion survey is the best way to find out whether others in the school would like to use an arts and crafts center during free time. • Students decide that they can best find out when other classes have available free time by sending a note to each teacher asking for a list of free time available to his/her students during the school day.
Working Cooperatively in Groups on Tasks	• After surveying other classes and receiving permission from principal to work on setting up an arts and crafts center, students form groups to determine materials and supplies needed, to formulate rules and set up a possible schedule, and to obtain funds needed for the center.

193

Making Decisions as Needed

- Students working on materials and supplies decide to survey other classes to determine the types of projects others would like to work on in the arts and crafts center.
- Students decide to survey a random sample from other classes rather than giving a survey to every student.
- After investigating several possible locations for the arts and crafts center, students determine the best location.

Utilizing and Appreciating Basic Skills and Processes

- Students draw graphs of survey results on types of arts and crafts projects preferred by students.
- Students measure furniture and rooms to determine the place for the arts and crafts center.
- Students recognize that setting up an arts and crafts center will help many students besides themselves.
- Students prepare and give an oral presentation of their survey results and suggested locations to the 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 preferences of others for arts and crafts projects, preferences for time to use center.
- Students visit another school to observe their arts and crafts center and record activities and materials available, number of people using arts and crafts center, times the center is available for use, and rules and regulations of center.
- Students use survey results on projects preferred by students to classify materials and supplies needed as things that can be obtained at no cost and things that must be bought.
- Students construct equipment and storage containers for the arts and crafts center.
- Students determine the number of people who can use the arts and crafts center comfortably by trial and then set up a tentative schedule and trial period for use of the arts and crafts center.
- See also MATHEMATICS list: *Classifying/Categorizing; Measuring.*
- See also SCIENCE list: *Observing/Describing; Classifying; Manipulating, Controlling Variables/Experimenting; Designing and Constructing Measuring Devices and Equipment; Measuring/Collecting, Recording Data.*

Carrying Out Data Collection Procedures--Opinion Surveying, Researching, Measuring, Classifying, Experimenting, Constructing (cont.)	• See also SOCIAL SCIENCE list: *Observing/Describing/ Classifying; Manipulating, Controlling Variables/ Experimenting; Collecting, Recording Data/Measuring.*
Asking Questions, Inferring	• Students ask what sorts of arts and crafts projects others would like to work on. They infer from survey results that most students are interested in drawing or painting, woodworking, papier-mache projects, and working with clay. • Students ask how they can determine the number of students who can use the arts and crafts center at any one time. They decide they will try using the center with various numbers of students from their class to determine the optimum number who can work comfortably. • 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 find that conducting a survey of project preferences gives them better information than randomly asking other students what sorts of arts and crafts projects they would like to work on. • Students realize that the personnel running the arts and crafts center at the other school and their own art teacher are both good sources of information on places to obtain materials and equipment.
Evaluating Procedures Used for Data Collection and Analysis, Detecting Flaws in Process or Errors in Data	• Students realize that their opinion survey on project preferences will give them more accurate results for the whole school if they use a random sample of children from other classes. • After seeing that actual use of the arts and crafts center is contrary to survey results on projects preferred by students, the class examines the survey questions and decides that they did not word their questions well. • See also MATHEMATICS list: *Estimating/Approximating/ Rounding Off.*
Organizing and Processing Data	• Students tally data from their opinion surveys and group them by grades to find out whether different grades are interested in different types of arts and crafts projects.

Organizing and Processing Data (cont.)

- Students construct a chart of materials and equipment needed for the arts and crafts center.
- See also MATHEMATICS list: *Organizing Data.*
- See also SCIENCE and SOCIAL SCIENCE lists: *Organizing, Processing Data.*

Analyzing and Interpreting Data

- Students find from interpreting opinion survey results that primary grades are most interested in working with clay or wood while intermediate grades prefer work with papier-mache or painting and drawing.
- 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

- Students decide, on the basis of survey data, to establish an arts and crafts center for the whole school.
- Students predict that more intermediate students will use the arts and crafts center than primary students.
- Students decide, based on survey data, to organize the arts and crafts center into four separate areas: painting and drawing, wood working, papier mache, and clay areas.
- 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 investigating possible locations for the arts and crafts center evaluate each in terms of size, availability, and convenience of use.
- Students discuss whether or not all those wishing to use the arts and crafts center will be able to do so during lunch period.
- Students evaluate possible rules for the arts and crafts center on the basis of fairness and practicality.

Trying Out Various Solutions and Evaluating the Results, Testing Hypotheses

- Students observe the use of the arts and crafts center during a trial period to evaluate their rules and the use of equipment and supplies.

Trying Out Various Solutions and Evaluating the Results, Testing Hypotheses (cont.)

- Students schedule primary and intermediate students during the same time period one week and separately another week to see whether the center runs more smoothly with a mixed or homogeneous age group.
- See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses/Modeling.*
- See also SOCIAL SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*

Communicating and Displaying Data or Information

- Students construct bar graphs and line charts of their survey results on projects preferred by primary and intermediate grades.
- Students distribute copies of the schedule and rules for the arts and crafts center to all classes.
- Students draw a map of the arts and crafts center showing location of various work areas and supplies.
- 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 Class

- Students set up and run an arts and crafts center for use during free time.

Making Generalizations That Might Hold True Under Similar Circumstances; Applying Problem Solving Process to Other Real Problems

- Students apply surveying skills acquired during work on Using Free Time to work on Eating In School.
- Students apply skills acquired in setting up arts and crafts center to work on Classroom Design.
- See also SCIENCE list: *Generalizing/Applying Process to New Problems*
- See also SOCIAL SCIENCE list: *Generalizing/Applying Process to Daily Life.*

Basic Skills

Classifying/Categorizing	• Classifying sets of materials for arts and crafts center. • Categorizing characteristics or properties of games. • Categorizing characteristics of games in more than one way, such as games of chance vs. skill, fun games vs. educational games, seat games vs. active games, dice games vs. card games. • Distinguishing sets and subsets of quantitative survey data on number of children interested in working on various arts and crafts projects or making and playing games. • See also SCIENCE list: *Classifying*. • See also SOCIAL SCIENCE list: *Observing/Describing/ Classifying*.
Counting	• Counting survey data on activities children prefer to do during free time. • Counting number of seconds and minutes when timing songs, number of meters and centimeters when measuring room, number of people who use the games or the art center. • Counting to read scales on rulers and meter sticks when constructing games or equipment for art center. • Counting by sets to find scale for graph axes. • Counting tosses of coins, dice, beanbags, or spins on spinner. • Counting sides and angles of polygons. • Counting faces, vertices and edges of polyhedra. • See also SOCIAL SCIENCE list: *Collecting, Recording Data/Measuring*.
Computation Using Operations: Addition/Subtraction	• Adding one-, two-, or three-digit whole numbers to find total tally of survey data on games or total measurement of Tri-Wall needed for containers for art materials. • Adding and subtracting minutes and seconds to determine total time center is used. • Subtracting to find differences between predicted and actual counts of the number of children who use the art center, or the games. • Subtracting one-, two-, or three-digit whole numbers to find ranges for graph axes or for measurement data, such as determining the amount of room space left for games or art projects.

203

Computation Using Operations: Multiplication/Division

- Multiplying whole numbers to find total measurement of boards for games, total area of art center.
- Multiplying or dividing to find scale for graph axes.
- Multiplying and dividing to convert from centimeters to meters and vice versa.
- Dividing to calculate the average number of children who use the art center or the games each week; the average number of minutes the center is used each week.
- Dividing to calculate the ratio of first graders to second graders who use various games.
- Dividing to calculate percentages.
- Using multiplication and division to increase or decrease measurements for scale drawings of the art or music center.

Computation Using Operations: Fractions/Ratios/Percentages

- Using mixed numbers to perform calculations, such as finding the total amount of time the center is used or number of games that can be made from materials available.
- Changing fractions to higher or lower terms (equivalent fractions) to perform operations such as calculating the percentage of students who utilized art center during trial period.
- Using ratios and fractions to convert from millimeters to meters or meters to feet.
- Using ratios to increase or decrease measurements for scale drawings, such as scale drawing of an arts and crafts center.
- Using fractions in measurement, graphing, graphic comparisons, or scale drawings.
- Calculating ratios from survey data, such as the ratio of boys to girls or the ratio of primary to intermediate children who want to play games, who want to have an art center.
- Using slope diagrams to compare ratios or fractions.
- Calculating actual measurements from scale drawings of the art center using ratio of scale drawing.
- Calculating percentage of students that use the art center during lunch time.
- Calculating percentage of students who can hit a basket from a given distance, percentage of times a spinner stops in a given place.

Computation Using Operations: Business and Consumer Mathematics/ Money and Finance	• Adding and subtracting dollars and cents to determine cost of setting up and maintaining an art center, to perform cost analysis on games being sold, to figure profit or loss on sale of games, to make change. • Multiplying to figure total profit on sale of games. • Multiplying whole numbers to find total cost of paints and paper needed for art center. • Dividing to find unit cost of paper, paints, glue to be used in art center. • Dividing to find cost of art materials per student. • Calculating percentage of profit from games being sold.
Measuring	• Using arbitrary units (e.g., children's paces) to measure length and width of art center. • Using different standard units of measure such as feet and inches, or centimeters and meters to measure area needed for a game, area needed for work table in art center. • Using different measuring tools, such as meter sticks and yardsticks, to measure art center. • Reading rulers, tape measures, meter sticks, yardsticks accurately. • Timing, using a watch or clock, to determine how long it takes to play a certain game, to find how long the center is used. • See also SCIENCE list: *Measuring/Collecting, Recording Data; Measurement.* • See also SOCIAL SCIENCE list: *Collecting, Recording Data/Measuring.*
Comparing	• Using the concept of "greater than" and "less than" in making comparisons of primary vs. intermediate children who use the games, supplies needed in the art center from week to week. • Comparing quantitative data gathered from various sources, such as ratings by different grade levels on preference surveys for games or types of art supplies or music. • Comparing qualitative information gathered from various sources, such as surveying various grade levels to determine preference for free time activities. • Comparing qualitative with quantitative data. • Comparing estimated and actual results, such as number of children who express interest in using the art center vs. number of students who actually use it.

Comparing (cont.)	• Making graphic comparisons of fractions and ratios on slope diagrams of yes responses vs. total responses from survey data. • Comparing results of tosses of dice or spins of spinners. • Comparing results of tosses of bean bags from different distances. • See also SCIENCE and SOCIAL SCIENCE lists: *Analyzing, Interpreting Data*.
Estimating/Approximating/ Rounding Off	• Estimating error in survey data on number of people who will use art center. • Estimating the number of people who will use the games or the art or music center. • Estimating size of sample required to determine fairness of a game, or of dice. • Estimating the number of students who can use the art center comfortably; amount of space required for storing all the equipment. • Determining when a measurement is likely to be accurate enough for a particular purpose, e.g., using measurements of art center and work tables to determine possible arrangement and number of tables that will fit. • Using approximation in constructing boards and other equipment for games. • Taking repeated measurements and using the median when measuring the art center. • Rounding off measurements while measuring art center, or music center. • Rounding off data after measuring art center or music center.
Organizing Data	• Tallying on bar graphs, histograms. • Tallying survey data on things other classes want to do during lunch period. • Ordering real numbers on number line or graph axis. • Ordering survey results on preference of free time activities. • Ordering standard units of measure, such as centimeters and meters when measuring the art center. • Tallying votes to determine class preferences for lunch period activities. • Tallying results of tosses of dice, bean bags. • See also SCIENCE and SOCIAL SCIENCE lists: *Organizing, Processing Data*.

Statistical Analysis

- Assessing predictability of larger sample of student preferences based on results from smaller sample, such as predicting the number of children who will use the games or the art center; predicting whether a game is fair or not.
- Finding and comparing medians of the data obtained in determining whether a die is fair or not.
- Interpretation of histograms, scatter graphs, Q-Q plots, cumulative distribution graphs.
- Finding quartiles and interquartile range from data on dice-tossing.
- Finding the statistical probability of an event such as a pair of dice showing a certain number.
- See also SCIENCE and SOCIAL SCIENCE lists: *Analyzing, Interpreting Data.*

Opinion Surveys/Sampling Techniques

- Conducting surveys on arts and crafts projects preferred by students or on games preferred by children.
- Defining data collection methods, makeup and size of sample.
- Devising methods of obtaining quantitative information about subjective opinions by having students vote for only a few choices out of the total or by devising a rating scale.
- See also SCIENCE and SOCIAL SCIENCE lists: *Analyzing, Interpreting Data.*

Graphing

- Using alternative methods of displaying data, such as graphs, charts, scale drawings.
- Making a graph form--dividing axes into parts, deciding on an appropriate scale.
- Obtaining information from graphs.
- Representing data on graphs.
  - Bar graph--plotting different lunch period activities vs. number of students who prefer those activities or wish to do them.
  - Conversion graph--plotting meters vs. centimeters to use when measuring to make game boards.
  - Cumulative distribution graph--plotting running totals of number of students using art center for a certain length of time or less.
  - Histogram--plotting number of students using art center for certain intervals of time.

Graphing (cont.)

- Line chart--plotting game preferences of students from various grade levels.
- Line graph--plotting noise level at different distances from the music or art center; noise level with music at different volume levels.
- Q-Q graph--plotting time spent in art center by boys vs. time spent in art center by girls.
- Scatter graph--plotting number of times a student used art center or gym per week vs. number of disruptions he/she caused in the school per week or number of bean bag tosses that go in basket vs. distance from basket.
- Slope diagram--plotting number of "yes" responses to a survey question vs. total number of students answering question.

- See also SCIENCE and SOCIAL SCIENCE lists: *Communicating, Displaying Data, Analyzing, Interpreting Data*.

Spatial Visualization/Geometry

- Drawing or constructing a design or model of a game.
- Constructing and using geometric figures such as squares, cubes, triangles, circles, in designing games, in designing dice.
- Using geometric relationships, such as area, volume, similarity, congruence, and symmetry when constructing a scale model of art center, or in constructing dice or dice replacements for games.
- Using standard mensurational formulas, such as Area = Length x Width to calculate the area of various rooms to determine most suitable room for the art center.
- Measuring and constructing using rulers, compasses, and protractors, such as in game design or dice design.
- Using the concept of "greater than" and "less than" to compare geometric figures, such as in the design of dice for games.

Areas of Study

Numeration Systems

- Using decimal system (metric system) in measuring areas of art room or classroom.
- Using fractions in measuring lumber needed for construction of games, furniture for art center (inches, fractions of inches--American system of measurement).
- Using decimal system in calculations involving money.

Number Systems and Properties	• See *Computation Using Operations*.
Denominate Numbers/Dimensions	• See *Measuring*.
Scaling	• Deriving information from scale drawing of art center. • Finding an appropriate scale (proportion) for a scale drawing of the art center. • Using a scale to draw and make representations in a scale drawing of the art center.
Symmetry/Similarity/ Congruence	• See *Spatial Visualization/Geometry*.
Accuracy/Measurement Error/ Estimation/Approximation	• 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	• Creating games that a maximum number of people can play in a limited space such as active games for a small area in the classroom or an octagonally shaped board game for eight people. • Using slope diagrams to find minimum costs of materials, maximum response to survey questions. • Minimizing cost in recommending equipment and materials for gym or art center. • Utilizing limited amount of space available for art center by arranging center to fit maximum amount of students. • Maximizing use of art center by proper scheduling of students.

Maximum and Minimum Values (cont.)	• Finding the shortest time to produce games in quantity; maximizing profit on games by considering both price and number that can be sold at a given price. • Obtaining maximum number of boards for board games from Tri-Wall or other materials available, while keeping size of game boards uniform.
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 USING FREE TIME UTILIZING SCIENCE

Process

Observing/Describing	• Observing and describing different types of arts and crafts projects such as drawing, painting, ceramics, sculpture, and leather craft. • Observing and describing different types of games such as board games, card games, memory games, active games. • Observing and describing materials and equipment needed for arts and crafts projects such as paints, crayons, clay, or paste. • See also SOCIAL SCIENCE list: *Observing/Describing/ Classifying.*
Classifying	• Classifying materials for arts and crafts projects according to size, shape, color, or texture. • Classifying arts and crafts projects or games according to number of participants, amount of space required, time required, or materials required. • Classifying games according to both activity and location: quiet seat games, indoor or outdoor active games. • See also MATHEMATICS list: *Classifying/Categorizing.* • See also SOCIAL SCIENCE list: *Observing/Describing/ Classifying.*
Identifying Variables	• Identifying space required for different arts and crafts projects as a variable to be measured. • Identifying length of time required to complete arts and crafts projects as a variable to be measured. • Identifying number of people interested in arts and crafts projects and number of people who can participate due to space, time, and materials limitations as variables to be considered. • Identifying length of time and space required to play a game as variables to be measured. • Identifying size, shape, layout as variables to be considered or measured when designing a board game. • Identifying variables to be measured or considered when developing rules and setup for active indoor games (e.g., distance from basket in bean bag toss). • Identifying noise as a variable to be measured (and minimized) when developing an arts center or games. • See also SOCIAL SCIENCE list: *Identifying Problems/ Variables.*

Defining Variables Operationally

- Defining space required for an arts and crafts project or for a game as the area taken up by those working on the project, or playing the game, measured in square centimeters or square meters with a meter stick.
- Defining the length of time required for an arts and crafts project or for a game as the time it takes to complete a project or game as measured in minutes and seconds with a stopwatch.
- Defining number of people interested in an arts and crafts project as the number of people who sign up for the project.
- Defining number of people who can participate in a project as the greatest number of students able to work comfortably on the project in a given space for a certain period of time.
- Defining size of board games as that measured in cm. with a ruler (length and width).
- Defining distance from basket in bean bag toss as the distance measured from thrower to basket in meters with a meter stick.
- Defining noise level as that measured by a VU-meter (a type of sound level meter) on a tape recorder.

Manipulating, Controlling Variables/Experimenting

- Testing projects set up in a certain space for a specific length of time using different numbers of students.
- Rearranging the space in the art center to accommodate several arts and crafts projects going on at the same time.
- Modifying projects so that they take a longer or shorter time to complete, so that they require more or less space.
- Experimenting to determine fair rules for games, e.g., trying different distances in bean bag toss game.
- Modifying games or arts center to minimize noise.
- See also SOCIAL SCIENCE list: *Manipulating, Controlling Variables/Experimenting.*

Designing and Constructing Measuring Devices and Equipment

- Constructing equipment and storage containers for the arts and crafts center.
- Designing and constructing games.

Inferring/Predicting/Formulating, Testing Hypotheses/Modeling	• Inferring from timing data that most students working on arts and crafts projects will need about four half-hour sessions to complete their projects. • Predicting that the art center will have to be open for longer periods during the day to accommodate all those interested in using it. • Hypothesizing that four different arts and crafts projects are the maximum number that can be going on at any one time in the art center; trying various arrangements of materials and furniture to see if this is so. • Hypothesizing that twice as many students can toss a bean bag into a basket if the distance is made shorter by two feet. Trying out new distance. • Making a scale layout of art center showing locations of tables, cabinets, and storage containers. • See also SOCIAL SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*
Measuring/Collecting, Recording Data	• Measuring amount of space required for a certain number of people to work on an arts and crafts project. • Measuring art center to determine amount of space available for various arts and crafts projects. • Timing students (with a stopwatch) to determine how much time is needed to complete different arts and crafts projects, to play various games. • Recording number of students who can work comfortably on various projects in a given amount of space and for a specific length of time. • Measuring different distances at which students toss bean bags and recording number of hits or misses at various distances. • See also MATHEMATICS list: *Measuring.* • See also SOCIAL SCIENCE list: *Collecting, Recording Data/Measuring.*
Organizing, Processing Data	• Ordering arts and crafts projects according to amount of space they require. • Ordering time measurements for different arts and crafts projects, for different games. • Ordering arts and crafts projects according to number of people who can work on them at any one time. • Ordering results of bean bag tosses according to distance of toss.

Organizing, Processing Data (cont.)	• See also MATHEMATICS list: *Organizing Data.* • See also SOCIAL SCIENCE list: *Organizing, Processing Data.*
Analyzing, Interpreting Data	• Determining number of people who can use art center at one time. • Determining median length of time needed to complete various arts and crafts projects. • Determining which arts and crafts projects to offer in art center based on data on space and time requirements of projects. • Determining best distance for bean bag game. • See also MATHEMATICS list: *Comparing; Statistical Analysis; Opinion Surveys/Sampling Techniques; Graphing; Maximum and Minimum Values.* • See also SOCIAL SCIENCE list: *Analyzing, Interpreting Data.*
Communicating, Displaying Data	• Constructing a chart showing proposed projects and times for art center, and number of people who can work on a project. • Drawing graphs to communicate data. • See also MATHEMATICS list: *Graphing.* • See also SOCIAL SCIENCE list: *Communicating, Displaying Data.* • See also LANGUAGE ARTS list.
Generalizing, Applying Process to New Problems	• Applying skills acquired in arranging and setting up art center to work on Classroom Design. • Designing new games for others. • Applying skills acquired in game construction to manufacturing most popular games to give or sell to others. • See also SOCIAL SCIENCE list: *Generalizing/Applying Process to Daily Life.*
Areas of Study	
Measurement	• Measuring Tri-Wall, cardboard, or lumber to make equipment, storage containers for art center, or boards for board games, using different measuring tools such as rulers and meter sticks.

Measurement (cont.)	• Observing the difference in length of time between seconds and minutes when timing free time activities (art projects, games, etc.) • See also MATHEMATICS list: *Measuring*.
Force	• Observing that force must be used to throw balls or bean bags when playing active games. • Observing that force must be used to hammer nails into lumber or Tri-Wall when constructing games or working on art projects. • Observing that saber saws are faster and require less effort to operate than hand saws when cutting Tri-Wall or lumber.
Mechanical Work and Energy	• Observing that work is done when nails are hammered into lumber when constructing games or working on art projects. • Observing that saber saws are faster than hand saws for cutting Tri-Wall or lumber and that they transform electrical energy into mechanical energy. • Observing that work is involved and energy is expended when playing active games (e.g., running, throwing). • See also *Force*.
Solids, Liquids, and Gases	
States of Matter	• Noting that glue is available in both solid and liquid form, each having different properties. • Observing that a solid stick of glue is turned into a hot liquid glue in the hot glue gun.
Properties of Matter	• Observing that paper materials available for arts and crafts projects or for making games have different colors, textures, and weights. • Observing that different construction materials, such as cardboard, Tri-Wall, and lumber, have different properties that make them useful for certain tasks. • Observing, while mixing tempera paints, that the dry powder mixes uniformly with the water. • Observing the effects of physical wear on games. • Observing that glues, paints, paper, and other materials have particular odors.

Electricity	• Observing that plugging in electrical machines enables the equipment to be turned on. • Observing that electrically run machines go on when the switch is closed and off when the switch is opened. • Observing that electrical energy can be transformed into sound (tape recorder), into mechanical energy (saber saw, electrical games), into heat energy (glue gun). • (If students choose to design and build games involving batteries and light bulbs, they will learn other concepts of electricity.)
Light	• Observing, while working on art projects, that it is easier to draw in a well-lighted area because objects become visible as light is reflected from them to the eye. • Observing that lettering on games being constructed may be difficult to read if the writing and background are similar colors and easy to read if colors are contrasting. • Observing that paints and crayons come in different colors.
Sound	• Measuring noise level in classroom, or art center while engaged in various activities. • Observing that a tape recorder or record player located in one part of the room may be heard in other parts of the room. • Observing that noise from the art center, or classrooms can be heard in adjacent rooms or in the hallway. • Observing that sounds in the classroom or art center differ in tone, pitch, and loudness. • Observing that noise levels in the classroom or art center are lowered when curtains or acoustical barriers are used in the room. • Observing that some electrical energy of machines is transformed into sound.

ACTIVITIES IN USING FREE TIME UTILIZING SOCIAL SCIENCE

Process	
Obsefving/Describing/Classifying	• Observing and describing activities engaged in by students during free time, e.g., reading, playing games at seat, playing active games, helping teacher, running around classroom. • Classifying activities of students observed during free time as quiet activities, busy activities, disruptive activities. • Classifying materials and equipment needed for art center to determine items that can be borrowed or obtained at no cost, and items that must be bought. • Classifying students taking part in certain free time activities according to age, grade level, sex, interests.
Identifying Problems, Variables	• Identifying problems of students in using free time constructively (nothing to do, bored with materials and games in room, tired of staying in seat). • Identifying amount of materials available as a problem in art center. • Identifying age and sex as possible factors in preferences for free time activities. • Identifying age, grade level, sex, and interests as variables that may affect the results of a survey. • See also SCIENCE list: *Identifying Variables*.
Manipulating, Controlling Variables/ Experimenting	• Surveying different groups to determine differences in preferences for free time activities and keeping results separate. • Scheduling several different types of free time activities for a trial period and observing which students engage in these activities to determine differences in preferences for free time activities. • Surveying students using art center during trial period to determine additional materials and equipment needed, and amounts needed. • See also SCIENCE list: *Manipulating, Controlling Variables/Experimenting*.

Inferring/Predicting/Formulating, Testing Hypotheses	• Inferring from survey results that most children prefer either active indoor games or board games. • Predicting materials and supplies that must be bought for art center and amount of money needed for such expenditures based on cost analysis and informal survey of those using art center. • Hypothesizing that more girls than boys will choose to use art center; testing hypothesis by observing use of art center for a trial period. • See also SCIENCE list: *Inferring/Predicting/Formulating, Testing Hypotheses.*
Collecting, Recording Data/ Measuring	• Counting votes to determine which games to play, which activities or projects are most popular in art center. • Counting number of people using art center or number of people playing games during trial period. • Using a voting procedure to determine which games are most popular in the primary classes. • See also MATHEMATICS list: *Counting; Measuring.* • See also SCIENCE list: *Measuring/Collecting, Recording Data.*
Organizing, Processing Data	• Tallying and ordering survey data from different groups on preferences for free time activities. • Tallying and ordering survey data on age, sex, interests of students preferring various free time activities. • Tallying and ordering votes to determine most popular games. • See also MATHEMATICS list: *Organizing Data.* • See also SCIENCE list: *Organizing, Processing Data.*
Analyzing, Interpreting Data	• Comparing survey results on preferences for free time activities for boys and girls, primary classes and intermediate classes. • Evaluating the way in which opinion surveys were administered, size and makeup of sample. • 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	• Constructing a chart of materials and supplies needed for art center, showing amounts needed and costs of those which must be bought. • Representing survey data on age, sex, interests of students preferring various arts and crafts projects on graphs or charts. • See also MATHEMATICS list: *Graphing*. • See also SCIENCE list: *Communicating, Displaying Data*. • See also LANGUAGE ARTS list.
Generalizing/Applying Process to Daily Life	• Gaining greater awareness of how to use time constructively at home as well as at school. • Applying surveying skills acquired during work on Using Free Time to investigation of Play Area Design and Use. • See also SCIENCE list: *Generalizing/Applying Process to New Problems*.

Attitudes/Values

Accepting Responsibility for Actions and Results	• Making sure that various tasks (e.g., getting needed equipment and materials for art center, scheduling times for use of art center) are done. • Observing and supervising use of art center, formulating fair rules for its use. • Scheduling and giving presentation to principal in order to present survey results and student suggestions concerning use of free time.
Developing Interest and Involvement in Human Affairs	• Organizing free time activities that are desired by others in the school as well as themselves. • Making games for students in other classes.
Recognizing the Importance of Individual and Group Contributions to Society	• Recognizing that setting up an art center will help many students. • Recognizing that many people in the school have contributed to setting up the art center.
Developing Inquisitiveness, Self-Reliance, and Initiative	• Conducting large and small group sessions with help from the teacher. • Investigating sources of equipment and materials for art center.

Developing Inquisitiveness, Self-Reliance, and Initiative (cont.)	• Investigating various rooms in the school to determine best location for art center. • Dealing with various sources (merchants, school personnel, parents) in obtaining equipment and materials for art center, for games. • Finding their own solutions to problems of scheduling and misuse of art center, in addition to main problem of challenge. • Choosing and developing best way of presenting ideas for free time activities to principal.
Recognizing the Values of Cooperation, Group Work, and Division of Labor	• Finding that work on setting up an art center or on making games progresses more rapidly and smoothly when done by groups. • Finding that work is more fun when people learn to cooperate. • Eliminating needless overlap in work when constructing games by cutting out all boards needed for board games at one time. • Finding that coordination between groups when investigating what materials and equipment are available saves time.
Understanding Modes of Inquiry Used in the Sciences, Appreciating Their Power and Precision	• Using scientific modes of inquiry to investigate and solve the problems of making a fair game, of creating games suitable for classroom or gym. • Using survey to determine students' preferences for games. • Convincing others through use of supporting data (opinion survey) that most students wish to work on art projects during their free time. • Seeing that various arrangements for the art center can be tried by using scale layouts. • Setting up a trial period for use of art center and observing use and problems before setting up a definite schedule. • See also MATHEMATICS and SCIENCE lists.
Respecting the Views, Thoughts, and Feelings of Others	• Considering all suggestions and assessing their merit. • Considering the opinions of others when proposing free time activities, conducting opinion surveys to determine others' preferences for free time activities or for types of games.

Being Open to New Ideas and Information	• Considering many possible types of arts and crafts projects. • Seeking out resource persons who can offer constructive advice about setting up art center. • Considering various possible arrangements for an arts center, including separate room, portion of classroom, etc.; considering suggestions from principal and other teachers about arts center.
Learning the Importance and Influence of Values in Decision Making	• Realizing that preferences for various free time activities reflect the values of each individual. • Realizing that primary students and intermediate students may have different values that affect their preferences for free time activities. • Realizing that cost alone is not a sufficient criterion for choosing equipment and materials for free time activities; preferences and abilities of others for use of equipment must also be considered. • Recognizing that age and sex may affect students' preferences for types of games.
Areas of Study	
Economics	• Using concepts and terms, for example, cost, retail price, wholesale price, when investigating costs of materials and equipment for art or music center or for games construction. • Gaining experience with finance: sources, uses, and limitations of revenues for purchase of materials and equipment needed for art or music center or for games construction. • Gaining experience in comparative shopping for materials such as art supplies, music equipment, materials for games. • Assessing preferences and characteristics of possible consumers of art materials or games through surveys or questionnaires. • Investigating costs of art supplies or sound equipment vs. use of equipment and budget restrictions. • Investigating economics of production and marketing and cost analysis of materials when producing games for sale. • Analyzing variables affecting consumer purchases, commercial sales.

Geography/Physical Environment	• Investigating and changing physical environment in classroom to provide space for active games, in school when setting up art center or music center, in play area when organizing outdoor recreation.
Political Science/Government Systems	• Investigating systems of administration and control; deciphering role of governing body over the body that is governed when setting up art or music center. • Determining need for rules and regulations for art or music center or for games. • Investigating regulations and policies affecting plans for art or music center or for use of games by other classes. • Getting in touch with and working with school authorities when setting up art or music center or when teaching games to other classes.
Recent Local History	• Investigating existing programs and centers to see how they are run. • Investigating previous attempts to establish activities, centers, programs for use during free time.
Social Psychology/Individual and Group Behavior	• Comparing survey results with actual observation of students using art center or games to determine whether responses to survey actually reflect what students do in their free time. • Analyzing the effects of a small group (students organizing art center or making games) making decisions for larger group (school population). • Assessing effects of group action in setting up an art center. • Recognizing the need for leadership within large and small groups. • Recognizing the differing capacities of individuals for various roles within groups.
Sociology/Social Systems	• Investigating differing needs of different social groups, such as primary vs. intermediate children or boys vs. girls, when organizing free time activities. • Considering the integral, related nature of the school community and its recreational and physical components as a factor in establishing free time activities and as

Sociology/Social Systems (cont.)

a source of support (parent volunteers, PTA funds) for free time activities.

- Devising a system of working cooperatively in large and small groups.
- Investigating problems of free time activities and making changes that affect not only themselves but also other students in the school community.
- Working within established social systems (such as the classroom and the school) to promote changes.
- Recognizing peer groups as social systems--age and grade separation at lunchtime, recess time--and differences in scheduling because of such social systems.
- Relating use of free time in school to use of free time after school, or at home.
- Recognizing that there are many different social groups and that one person belongs to more than one social group.

ACTIVITIES IN USING FREE TIME UTILIZING LANGUAGE ARTS

Basic Skills

Reading: Literal Comprehension--Decoding Words, Sentences, Paragraphs	• Decoding words, sentences, and paragraphs while reading catalogs to check on art supplies, sound equipment, instructions for use of sound equipment, books on games, game construction.
Reading: Critical Reading--Comprehending Meanings, Interpretation	• Obtaining factual information about art supplies, sound equipment, sports equipment while reading catalogs, instruction sheets. • Understanding what is read about art supplies, sound equipment, and games. • Interpreting what is read, such as catalogs, instruction manuals, books on games.
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 on activities of small groups involving work on art center or game construction. • Responding to criticisms of activities. • Conducting opinion surveys. • Preparing and giving effective oral presentations of survey questions, methods, findings and suggested solutions to class. • Preparing and giving effective oral presentations of survey results and student suggestions to principal. • Using the telephone properly and effectively to obtain information on materials and equipment needed for art or music center or for games. • Teaching others how to play games, how to use equipment properly. • Using rules of grammar in speaking.
Oral Language: Listening	• Listening to suggestions and ideas of various school personnel (principal, librarian, art teacher) when planning free time activities. • Conducting interviews of students and teachers to determine use of art center or games; to elicit suggestions for improvements of art center or games. • Following spoken directions.

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: • writing opinion survey(s), devising questions to elicit desired information; judging whether a question is relevant and whether its meaning is clear. • preparing clear and succinct rules for use of art or music center. • preparing clear and succinct games rules and instructions. • preparing booklets on instructions for use of art equipment or sound equipment. • preparing schedules and charts for use of art or music center.
Study Skills: Outlining/Organizing	• Taking notes on various types and costs of equipment for art or music center, on use of art center while observing students. • Developing opinion survey; ordering questions around central themes, such as student preferences for various free time activities. • Planning presentations and data collection schemes. • Planning and preparing drafts of rules and schedules for use of art or music center for critical review by class before final copy is written. • Extracting important ideas from completed opinion surveys, recombining them and restating them when necessary. • Organizing ideas, facts, data when planning art or music center. • Organizing instructions and rules for games.
Study Skills: Using References and Resources	• Using the library to research information on arts and crafts projects for art center, different types of games. • Inviting school personnel having knowledge or information pertaining to free time activities to speak to the class and answer questions for them. • Using catalogs to research information on materials and equipment needed for free time activities.

Study Skills: Using References and Resources (cont.)	• Using indexes and tables of contents of books to locate desired information. • Using "How To" Cards for information on how to construct bar graphs and line charts of opinion survey data.
Attitudes/Values	
Appreciating the Value of Expressing Ideas Through Speaking and Writing	• Finding that various school personnel will cooperate in obtaining space and equipment for free time activities when presented with well-prepared student suggestions. • Finding that distributing rules and schedules for use of art or music center to other classes results in better use of these facilities.
Appreciating the Value of Written Resources	• Finding that certain desired information can be found in catalogs and books such as information on equipment and materials for free time activities. • Finding that a set of written rules for a game is essential if others are to play it.
Developing an Interest in Reading and Writing	• Willingly looking up information on materials and equipment for an art or music center, on different types of games and activities for free time. • Looking up more detailed information on materials and equipment needed for art or music center. • Showing desire to work on drafting rules and instructions for games, instruction booklets for use of equipment, rules for use of art or music center. • Experimenting with different ways to tell others about rules and activities for art or music center.
Making Judgments Concerning What Is Read	• Checking to make sure that rules and instructions for games are clear, accurate, and consistent. • Checking to make sure that rules and instructions for use of art or music center are clear and consistent. • Deciding whether rules and instructions for games, and for art or music center are appropriate, whether they say what they are supposed to say, whether they need improvement. • Deciding whether information obtained about materials and equipment through reading is applicable to the needs of art or music center. • Deciding how reliable the information obtained from reading is.

Appreciating the Value of Different Forms of Writing, Different Forms of Communication

- Finding that how information on playing games or on using art or music center can best be conveyed is determined in part by the audience to whom it is directed.
- Finding that certain information about playing games or using art or music center can be best conveyed orally or in pictures.
- Finding that certain data or information, such as rules and schedules for use of art or music center, can be best conveyed by writing it down or by preparing charts.
- Finding that certain data or information, such as observations of students using art or music center, 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 (e.g., when teaching games or showing students how to use a piece of equipment) and vice versa.
- Investigating the effect of different forms of communications on people when advertising use of the art or music center.