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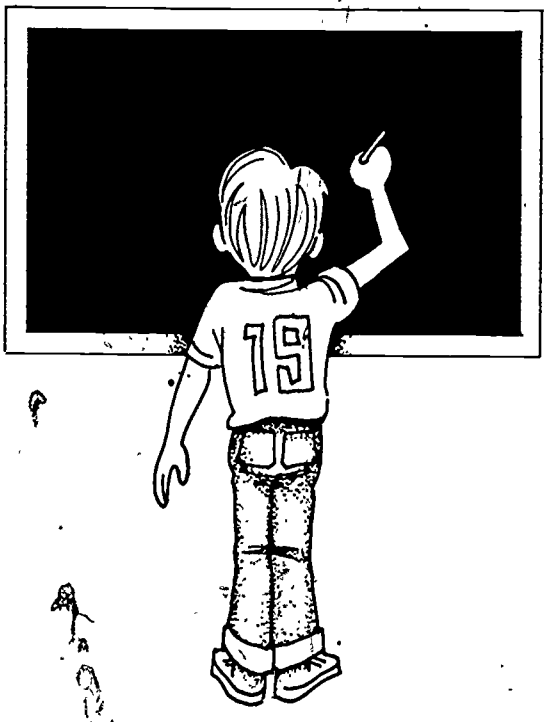
ABSTRACT

This demonstration project provides intensive instruction in reading and mathematics to selected fifth graders in the 1974-75 year and for selected fifth and sixth graders in 1975-76 in order to raise the reading and mathematics performance of underachievers to a level commensurate with measured ability. The sharing of learning activities in mathematics, which teachers have found effective for underachievers, is the main purpose of this resource. The document supports the theory that a sound curriculum in mathematics for elementary schools is characterized by both mathematical content and an approach to teaching consistent with the best available knowledge of learning in children. Its main focus is on activities used in teaching children about operations on whole and fractional numbers. The learning activities included give instructional suggestions for each of the 35 minimal objectives specified for the program. The importance of the teacher's recognition of four types of errors is emphasized for eventual diagnosis and remediation of failure. Brief guidelines for both diagnosis and remediation are provided. Also offered are some suggested methods of motivating low-achieving pupils; namely, extrinsic and intrinsic motivators. The importance of record keeping in individualized instruction is also stressed and forms included here facilitate the individual monitoring of pupil progress. (Author/AM)

MATHEMATICS:

Activities That Work



SUPPLEMENTAL SKILL DEVELOPMENT PROGRAM

Division of Elementary Education ● State Department of Education ● Richmond, Virginia 23216

ACKNOWLEDGMENTS

Appreciation is expressed to the many educators in Virginia who have made this publication possible. In the spring of 1975 the Division of Elementary Education, State Department of Education, solicited teaching ideas, techniques, and strategies which local school division personnel had found effective with underachieving pupils selected for the Virginia Supplemental Skill Development Program. Materials submitted by teachers were utilized to develop this teaching resource book for mathematics.

Appreciation also is expressed to members of the Supplemental Skill Development Program Committee who devoted much time and concentrated effort in the production of the resource book.

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PREFACE

The Virginia Supplemental Skill Development Program, mandated by the 1974 session of the Virginia General Assembly, is a demonstration project providing intensive instruction in reading and mathematics for selected fifth-grade pupils in the 1974-75 school year and for selected fifth- and sixth-grade pupils in 1975-76. The primary purpose of the program is to raise the reading and mathematics performance of underachieving pupils to a level commensurate with measured ability.

The purpose of this resource book is to share learning activities in mathematics which teachers have found effective for underachieving pupils. The learning activities give instructional suggestions for each of the 35 minimal objectives specified for the program. It is suggested that the teacher add other ideas to the book, expanding it into a larger compilation of teaching ideas for personal use. Although, as noted earlier, the Supplemental Skill Development Program is designed for fifth- and sixth-graders, it is hoped that the activities suggested in this book will be useful for teachers of other grades.

This book deals with mathematics. A companion book for reading, entitled, "Reading: Activities That Work," has been published. It is hoped that the two books will prove useful to teachers in their efforts to meet the assessed needs of pupils.

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I. OVERVIEW

PURPOSE

Purpose of the Supplemental Skill Development Program

Is there one sure method of raising the performance level of elementary school pupils who show potential but are low-achievers? Unfortunately, the answer seems to be "no." At least, no one yet has found a suitable solution. Due to the efforts of the Virginia General Assembly, school divisions throughout the State have been given the opportunity to study this question and ascertain some answers.

In 1974 the General Assembly appropriated funds for the Supplemental Skill Development Program as a two-year pilot project. Its purpose: "To raise the average achievement level of students in Virginia as measured by standardized tests to equal or exceed the average level of the student population as measured by scholastic aptitude tests." The program centers on minimal essentials in reading and mathematics and is aimed at a select group of children whose work consistently falls below their potential.

School divisions in Virginia were alloted funds on a per pupil basis for the Supplemental Skill Development Program and were encouraged to develop individualized programs at the local level. The program was designed to be flexible enough to allow each school division freedom in choosing personnel, materials, and organizational methods best suited to local needs, within a framework of statewide objectives. In this way, the General Assembly hoped not only to increase the performance of selected fifth- and sixth-grade pupils, but also to find new and better ways of teaching basic skills to all children in Virginia. Thus, the effort is a special demonstration or pilot project with much broader future implications.

Purpose of Book

The purpose of the book is twofold. First, it is designed to inform teachers about the policies, possibilities, and objectives of the Supplemental Skill Development Program. Second, it should assist teachers in implementing the program through specific suggested activities. This book concerns only mathematics; a companion book for reading skills has been published. The purpose of the mathematics book is to help teachers plan and teach the minimal skills to help pupils achieve mastery of the fundamental computational operations. It is hoped that the suggested activities will aid teachers in facilitating mathematical achievement for fifth- and sixth-grade children and stimulate them to develop effective instructional techniques.

PHILOSOPHY

Philosophy of Program

What about philosophies—the ideas behind both the program and this book? The philosophy of the Supplemental Skill Development Program is based on an awareness that a problem exists with low-achieving children, particularly those whose actual performance is below projected potential. The General Assembly recognizes that schools must go beyond "normal" considerations in reaching low-achievers. Thus, supplementary funds were appropriated by the General Assembly to support efforts toward alleviating the problem. This approach to the problem assumes that each division knows the learning needs of its pupils and, therefore, can determine how effective programs should be formulated. Inherent in this assumption is the fact that no universal answers exist, subsequently, the program is mainly concerned with developing a wide range of possible solutions to a very real problem.

Philosophy of Book

The basic philosophy reflected in this book is an operational one. The suggestions presented should help the teacher to reach low-achievers in mathematics. The book supports the theory that a sound curriculum in mathematics for elementary schools is characterized by both mathematical content and an approach to teaching consistent with the best available knowledge about how children learn. The book is concerned with individualized instruction as well as the mathematical performance of elementary school children. The main focus is on activities used in teaching children about operations on whole and fractional numbers. A list of 35 minimal objectives has been compiled. The book contains teaching activities to help pupils understand specific concepts and perform particular mathematical tasks.

INFORMAL DIAGNOSIS

For elementary school children, errors in mathematics are a major source of frustration. It is essential that elementary school teachers be able to diagnose mathematical errors quickly and accurately to correct the difficulties pupils are experiencing. Diagnosis as a teaching tool enables teachers to determine pupil strengths and weaknesses in performing mathematical operations. Through diagnosis and remediation the teacher should be able to employ effective methods of instruction. This section focuses on three areas of

diagnosis and remediation that are useful to teachers in the Supplemental Skill Development Program: types of errors, guidelines for diagnosis, and guidelines for remediation.

The topic of diagnosis is an extremely complex one and cannot be covered comprehensively in the brief manner necessary in this book. For this reason a bibliography is included for the teacher who is interested in further exploring this aspect of instruction. The bibliography at the end of this section includes references which should be available to elementary school teachers.

Types of errors

In a study of mathematical computation and a diagnosis of failure, four classifications of failure are identified. They are:

Guessing

Guessing occurs when the pupil displays no knowledge of how to solve the problem at hand. Teachers must be careful when applying this classification, however, since the pupil may have used a perfectly consistent, though incorrect, strategy in attempting to solve the problem. This response predominates among children who have very little mathematical ability.

Easily recognized errors

Easily recognized errors occur when the pupil uses the correct operation and obtains an incorrect answer and when basic number facts cannot be recalled. Example, the response "17" to the stimulus

$$\begin{array}{r} 9 \\ +9 \\ \hline \end{array}$$

is an easily recognized computational error. Drilling in basic number combinations probably would be effective in correcting errors.

Incorrect operations

Incorrect operations occur when a pupil tries to solve a problem by using an operation other than the one required to solve the problem correctly. Example, if a pupil responds to the stimulus

$$\begin{array}{r} 5 \\ -2 \\ \hline \end{array}$$

with the answer "7", it is evident an incorrect operation has been used. More careful training in stimulus and response discrimination while teaching the basic mathematical operations is likely to help alleviate this type of error.

Incorrect algorithms

Incorrect algorithms occur when the pupil commits an error which is not a number fact error. This category is by far the broadest of the four, and thus more frequent errors of this type occur. An example is:

$$\begin{array}{r} 79 \\ +46 \\ \hline 116 \end{array}$$

It is obvious that the pupil added the columns of numbers in reverse order. This inversion of order, in addition to grouping errors and mixed operations, is the major type of error in this classification.

Recognizing these four types of errors should give the teacher a better position from which to choose methods that will best help pupils to overcome difficulties in mathematics.

Guidelines for Diagnosis

The brief guidelines for diagnosis which follow are intended to give teachers a summary of suggestions and principles to keep in mind while working with pupils in the Supplemental Skill Development Program.

Be receptive

Since diagnosis is such a personal process, it is necessary that pupils be aware of their failures as well as their successes. Thus, teachers are encouraged to work on an individual or small group level if possible. An open and receptive attitude by the teacher could be the first step toward correcting a pupil's problems in mathematics.

Collect as much data as possible

Generally where more data are available, the judgment which follows diagnosis is more adequate. It is essential, however, that the teacher avoid instructing or pointing out errors the pupil may make while the diagnosis is being conducted. If the pupil sees that information only is being collected and that no attempt is being made to teach or correct mistakes, he is much more likely to respond consistently and honestly. Of course, this will give the teacher a more accurate picture on which to base later attempts to correct the problem.

Interview the student

Interviewing refers to the method where a pupil "thinks aloud," and tells the steps he went through in solving a problem. This technique reveals errors in thinking as well as errors in computation. It is suggested that an interview be conducted at the beginning

of the school year and at appropriate intervals during the year. In this way, the teacher can see the effectiveness of instruction as reflected in the way the pupil approaches a problem and can measure the progress of each child. Variations in computational strategies among pupils need not be changed for consistency's sake; instead, teachers should work toward developing each pupil's most efficient problem solving strategies.

Try to find error patterns

Collected data, including written, verbal and observed, should be analyzed with an eye toward consistent patterns rather than isolated events. Repeated use of incorrect definitions or consistent use of improper procedures are the kinds of patterns most likely to be helpful to teachers in their diagnosis.

Using these guidelines as a framework the elementary teacher should, with practice, be able to use diagnosis when making judgments as to how and what pupils are learning. Diagnosis provides the teacher with insight into which skills in the mathematical heirarchy the pupil still needs to learn. Time spent in the diagnostic process is of little value unless it is followed by an effective remedy.

Guidelines for Remediation

After all data have been collected and patterns are discernable, remediation is the next step for teachers to take. The following list of suggestions is deemed most appropriate for pupils in the Supplemental Skill Development Program.

Strengthen the pupil's self-image.

A pupil who has experienced repeated failure needs to feel that he is intrinsically worthy. When a pupil feels good about himself, his feelings are positive and he learns with greater ease.

Present instruction in small steps

While a big task may appear overpowering to an elementary school pupil, instruction based on a carefully constructed sequence of small tasks can be effective. Presenting instruction in manageable steps helps the pupil to realize that specific goals are attainable.

Utilize a variety of learning materials and activities

Adequate mathematical concept development requires that pupil interests and level of maturity should govern the types of materials used for each learning activity. The availability of a variety of learning materials and activities affords choices for the pupil and assists him in recognizing that if he fails to learn in one way, alternatives are open to him. There is no specific learning material that will prove effective for all pupils; neither is there any indispensable material or teaching method.

Permit the pupil to select from a variety of materials

It is important that the pupil be permitted to exercise preference in selecting learning materials. The pupil should be allowed to select from a variety of materials appropriate to the assigned learning task.

Foster the ability to estimate

Guidance in learning to estimate should be a part of the instructional program. Errors in computation will become less frequent as the pupil increases his ability to determine the reasonableness of his answers.

Help the pupil to employ aids when deemed necessary

Aids are designed to help the pupil understand an algorithm. They are usually given up when the pupil feels secure without them.

Divide practice into short intervals of time

Practice is usually more effective when spread over short periods of time. Practice periods should be spaced according to the pupil's attention and concentration spans.

Provide practice activities that afford immediate feedback

Select practice activities and games which will strengthen skills, and let the pupil know at once if the answer is correct. Such reinforcement encourages self-progress. Practice should be engaged in at the point of error.

Assist the pupil in making mathematical applications

Learning occurs more readily and is retained for a longer period of time when acquired skills are related to practical applications.

Foster self-evaluation by the pupil

The pupil shoud be involved in the evaluation process from the beginning of instruction and should help set the goals for learning and participate in his own evaluation.

Encourage the pupil to record daily and/or weekly progress

Profile charts kept by the pupil to indicate daily and weekly progress may serve as a motivational device and also afford satisfaction in accomplishment.

Learning acquired with purpose is retained more

effectively than that without purpose through meaningless drill. Drill is desirable only when the activity or process being practiced is an efficient one. Learning takes place when children are actively involved in stimulating experiences commensurate with their level of achievement.

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MOTIVATION

Of all the differences that exist among teachers, there is at least one point of basic agreement: pupils need to be better motivated to learn mathematics. Although

the problem is not a new one, in recent years it has received more and more attention from researchers and teachers alike. A recent survey by the National Council of Teachers of Mathematics, for example, supports the position that greater effort needs to be made to motivate elementary school children to learn mathematics. Every teacher knows that when pupils are motivated they make the strongest responses. Yet every teacher also knows that no amount of motivation can trigger responses relative to learnings pupils have not yet acquired. So motivation alone, without appropriate experiences, cannot induce learning.

There exist today many different theories of motivation which are too numerous to consider in this publication Perhaps more important than the theories themselves is the research which will translate theory into practicable classroom technique. Unfortunately, such research does not exist in a universally satisfactory form. From available data it can be deduced that there are some general ideas teachers may use to increase the motivation of pupils. The arousal factor of motivation is concerned with enhancing the pupil's attentiveness to the task at hand so that he is more receptive to learning mathematics. Another motivational factor is pupil expectancy, which involves describing for the pupil in concrete terms what he will be able to do (his new capabilities) at the conclusion of instruction. A final factor involves incentive with emphasis on rewards for present achievement contributing to achievement in the future.

Since teachers in the Supplemental Skill Development Program are probably most interested in the arousal and incentive factors, this book will offer some suggested methods of motivating low-achieving pupils. In general, the methods of motivation take two basic forms: extrinsic motivators and intrinsic motivators. An extrinsic motivator, as the name implies, makes use of worldly goods and activities to spur children to greater accomplishments. The use of such rewards as coins which can "buy" time on the playground or points which accumulate to show accomplishments have been used effectively in motivating children to complete their tasks. Teachers must administer extrinsic rewards carefully. Rewards may appear so attractive in themselves that some pupils might take short cuts to achieve success in order to receive the reward. For this reason, the teacher should set clearly defined standards for the successful completion of a task.

Intrinsic motivators, on the other hand, stress reinforcement which comes from inner contentment for having achieved success in a particular task. There are several different types of intrinsic motivators. The first is expectation. Simply expecting a low-achieving pupil to do a job often motivates him to get the job done, provided he is mathematically ready for it. Of course, this approach must be used realistically, with the pupil's progress kept in mind at all times. Expectations which are too ambitious could be more destructive than constructive in motivating low-achieving pupils. The second intrinsic motivator is hope. Many elementary school children who perform below their potential are plagued by continual lack of hope. Their backgrounds often discourage ambition or hope for success. To compensate for this deficiency of hope, the teacher must provide frequent opportunities for the pupil to show success. Again, though, the chances to perform well and thus build up hope must be selected carefully so that they are within the capability of the pupil.

Example, also, is an effective intrinsic motivator. The teacher interested in motivating pupils must demonstrate his own motivation, enthusiasm, and desire to learn if he wants his pupils to follow suit. Without a positive example, a pupil cannot be expected to show any enthusiasm for learning.

Perhaps the most effective motivator is success itself. The low-achiever has a history of failure, and the teacher's goal is to transform this failure into success. To do this, the tasks first assigned must be within the limits of the pupil's ability. As the pupil gradually realizes that he can succeed in mathematics, the teacher is working to make this success satisfying. Though extrinsic awards may be more satisfying to the low-achiever in the beginning, eventually, if his progress is closely supervised, the satisfaction of succeeding in a task will become more valuable.

Finally, feedback, or finding out information about one's own efforts, also can be a source of motivation. Telling the pupil his answer is wrong is a kind of feedback, but the teacher interested in motivating pupils will rely more on praise for accuracy, or at least praise for a close approximation to the correct answer. It is important that feedback be received as soon as possible after a task is completed.

Elementary school teachers also are advised to provide innovations to make the classroom more interesting and prevent the child from getting restless or bored. A friendly, relaxed atmosphere can help a pupil to be more receptive and thus motivate him to learn mathematics.

RECORD-KEEPING

Whenever teachers attempt to individualize instruction as the Supplemental Skill Development Program suggests they do, one of the first problems they face is record-keeping. Without a support system, it is almost impossible for the teacher to keep up with each pupil's progress. This, of course, is due to the fact that

where instruction is individualized pupils work on different skills and at different levels. For instructional purposes, elementary school teachers need to identify, systematically and as quickly as possible, which skills a pupil is attempting to master at a given time. This kind of information is essential for teachers to have to make effective decisions concerning the methods of instruction to be used. Individualized instruction, as suggested by the Supplemental Skill Development Program, includes at least five different modes. independent study, large group work, peer help, small group work, and tutorial sessions. Because of this, it is deemed appropriate for this book to offer some suggested methods for record-keeping which, it is hoped, will benefit pupils and teachers alike.

While it is difficult to produce a record-keeping model acceptable to all teachers, it is felt that the forms provided here could be modified to meet the individual needs of many school divisions for both administrative and instructional purposes. The first, identified as a "Classroom Progress Chart," is designed to allow the teacher to monitor individual pupil progress and at the same time have available a current account and overview of the entire class.

At the top of the page are listed the 35 mathematic objectives of the Supplemental Skill Development Program. In the spaces provided by each pupil's name, the teacher either colors in the block (to indicate skills already mastered), or draws a diagonal line from the right upper corner to the left lower corner (to indicate skills presently being mastered). When the teacher considers a new skill has been completely mastered by a pupil, he enters in the block the date on which this occured.

For teachers who believe it is beneficial for the pupil also to record his own progress, as suggested in the "Diagnosis" section of this book, a second form is given. Entitled "My Mathematics Skill Mastery Thermometer," it lists the 35 Supplemental Skill Development Program objectives. The pupil initially colors the spaces for skills he has already learned and colors succeeding spaces as new skills are acquired.

Teacher: _____

School: _____

Pupil's Name	Place Value	Number Relationships	Add: 2 one-place #	Add: one-to-four place numbers	Add: one-to-four place numbers	Add: word problem one-to-four place #	Subtract: with numbers less than 19	Subtract: one-to-four place numbers	Subtract: one-to-four place numbers	Subtract: word problem one-to-four place #	Multiply: two one-place numbers	Multiply: one-place factor	Multiply: two-place factor
Westinghouse Learning Course Objective Number	02	17	14	15	16	12	18	19	20	13	03	21	04
						C L A S S R O O M							

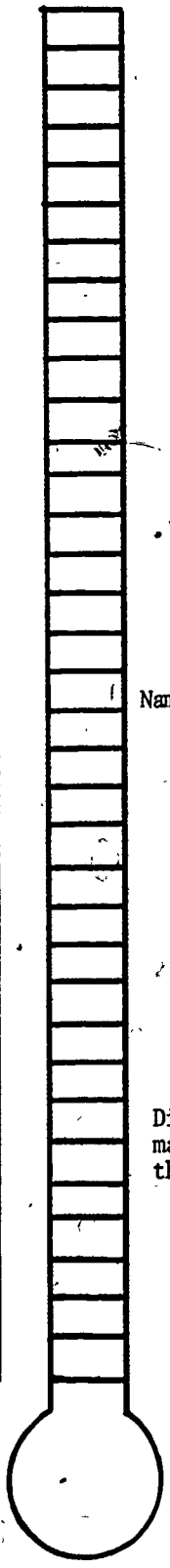
Divide:1-to-4 place # by a 1-place divisor	Divide: 1-to-4place # by a 1-place divisor	Fractional Parts	Add: fractions with like denominators	Add:mixed numbers with like denominators	Subtract: like fractions	Subtract: mixed numbers	Multiply: whole number times a fraction	Multiply: two fractional numbers	Add:mixed numbers with decimal fractions	Subtract: mixed numbers	Multiply: word problem in dollars & cents	Identify: line, line segment, ray, angle	Identify: Parallel,perpendicular	Identify: plane figures	Measure: line segment to fraction of inch	Measure: line segment to nearest inch	Sq. Units: Area of rectangle	Time: to nearest quarter hour	Liquid Volume: ounce pint, quart, gallon	Temperature: write temp. from thermometer	Interpret Bar Graphs
05	06	01	07	22	08	09	26	23	24	25	27	28	11	29	30	31	32	10	33	34	35

M P R O G R E S S C H A R T

Code: Initial Mastery; Skill Presently Being Mastered; 5-2 / 7-5 Date Mastery Was Attained

*	GOAL
35	Interpret Bar Graphs
34	Temperature: write temp. from thermometer
33	Liquid Volume: ounce, pint, quart, gallon
10	Time: to nearest quarter hour
32	Sq. Units: Area of rectangle
31	Measure: line segment to nearest inch
30	Measure: line segment to fraction of inch
29	Identify: plane figures
11	Identify: Parallel, perpendicular
28	Identify: line, line segment, ray, angle
27	Multiply: word problem in dollars & cents
25	Subtract: mixed numbers
24	Add: mixed numbers with decimal fractions
23	Multiply: two fractional numbers
26	Multiply: whole number times a fraction
09	Subtract: mixed numbers
08	Subtract: like fractions
22	Add: mixed numbers with like denominators
07	Add: fractions with like denominators
01	Fractional Parts
06	Divide: 1- to 4-place numbers by a 1-place divisor
05	Divide: 1-to-4 place # by a 1-place divisor
04	Multiply: two-place factor
21	Multiply: one-place factor
03	Multiply: two one-place numbers
13	Subtract: word problem one-to-four place #
20	Subtract: one-to-four place numbers
19	Subtract: one-to-four place numbers
18	Subtract: with numbers less than 19
12	Add: word problem one-to-four place numbers
16	Add: one-to-four place numbers
15	Add: one-to-four place numbers
14	Add: 2 one-place numbers
17	Number Relationships
02	Place Value

* Westinghouse Learning Corporation Objective Number



MY

Mathematics

Skill Mastery

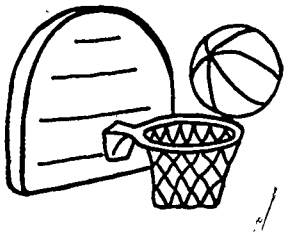
Thermometer

Name _____

Directions: Each time you master an objective, color the corresponding unit red.

II. ACTIVITIES

Objectives and Selected Learning Activities



GOAL #1:
The student will be able to identify or write the correct place value for a digit in a given seven-place number.

PRE-ACTIVITY LEARNING: Pupils have learned place names for whole numbers not to exceed six places.

ACTIVITY #1 ..... Choosing the Value of the Underlined Digit

MATERIALS:

Large sheet tagboard divided into 6 columns and 20 rows

6 markers shaped like cars, ships, or airplanes

40 cards on which are written one to six digits, one digit being underlined. Cards are numbered in lower right corner.

Coffee or peanut can for the cards

Key showing number of cards and the correct answer

NUMBER OF PLAYERS:

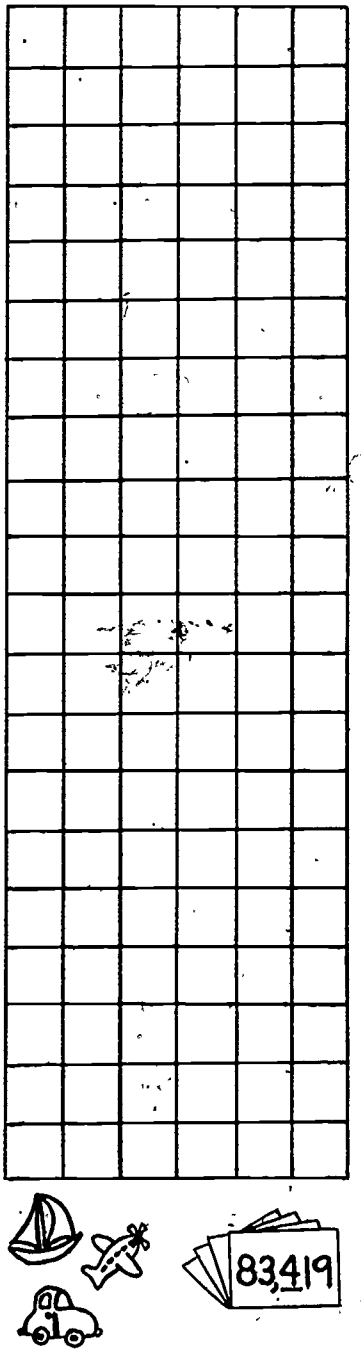
Two to six players. If desired, one player may be selected "teacher"; he checks the answers, using the key.

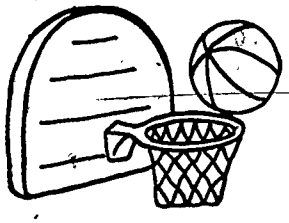
DIRECTIONS:

Players choose their markers and place them on the bottom row of the tagboard. Taking alternate turns, one player draws a card from the can. He reads the number and tells the value of the underlined place. If he reads it correctly, as determined by the "teacher," he moves three spaces. If he is wrong he does not move his marker. The first one to reach the top row is the winner.

FOLLOW-UP:

The teacher should check with the children during or immediately after the game to assess the degree of difficulty. If the children are making too many mistakes, the teacher will want to do some reteaching.





GOAL #2:
The student will be able to identify or write the relationship between two one- to four-place numbers, as greater than, less than, or equal to.
(Symbols are not used.)

PRE-ACTIVITY LEARNING: Teacher has shown the number line and presented criteria for judging number relationships.

ACTIVITY #1 ..... **Tic Tac Toe**

MATERIALS:

Tic tac toe board shown, enlarged to convenient size

Pile of cards on which are written pairs of numbers within some range such as 1-20, 20-99, 100-1,000. Each pair is separated by a comma.

Each card is numbered in lower right corner.

Key with answers corresponding to numbers on lower right corners

Set of 3 markers each, every set being a different color

NUMBER OF PLAYERS:

Two or three players. One player may be selected to verify the answers using the key.

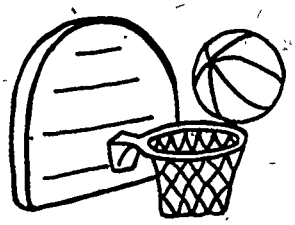
DIRECTIONS:

Three markers of the same color are given to each player. A player draws a card, compares the left number with the right number and places one of his markers in the correct space on the game board. He must take his marker off if it is incorrect. Play passes to the next child. The first person to place 3 in a row is the winner.

FOLLOW-UP:

The teacher should check to see if the children are making many mistakes, or he may want to be present during the play. The teacher may find it necessary to give new explanations for determining which of two numbers is larger (or smaller).

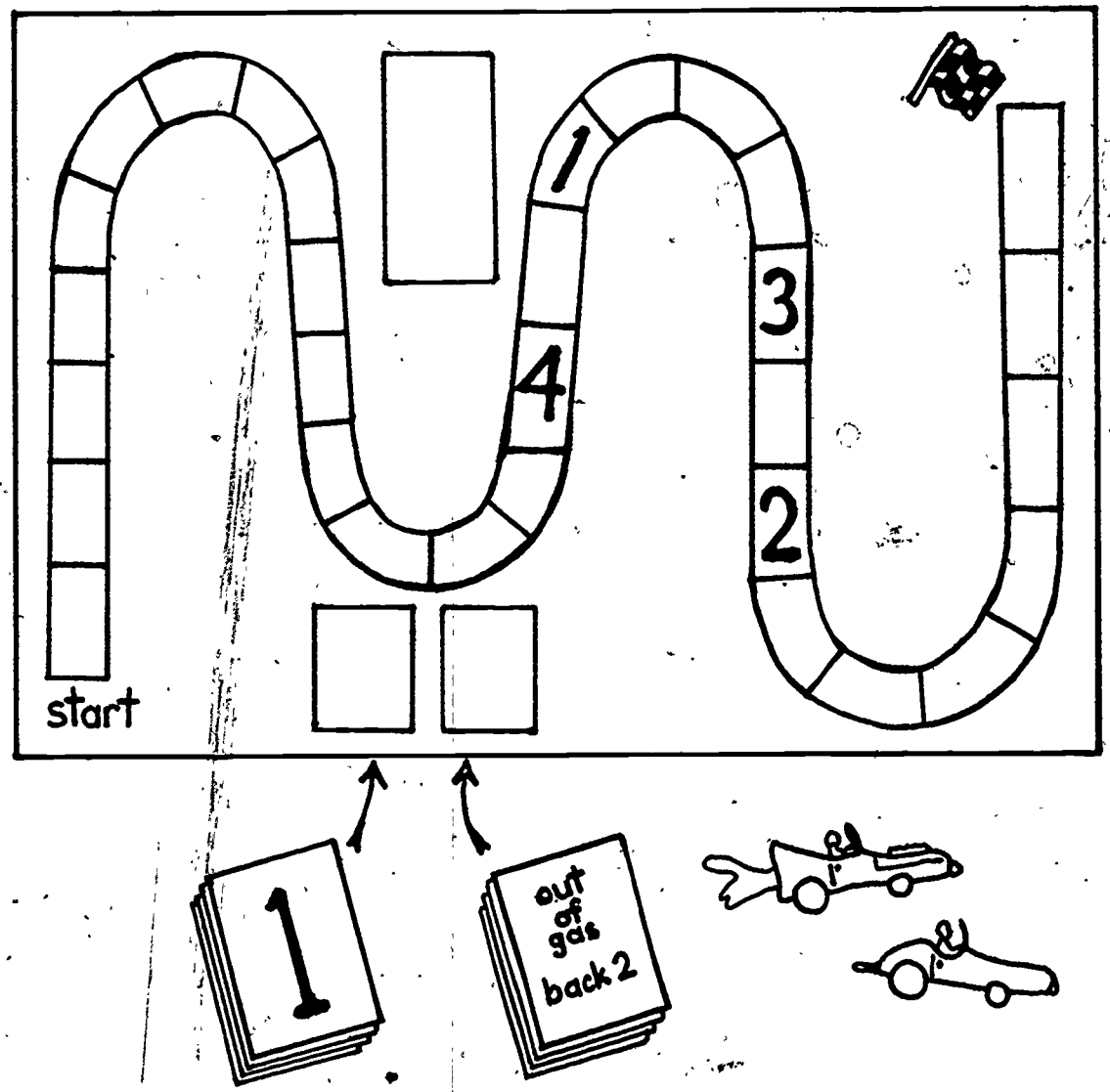
greater than	equals	less than
less than	equals	greater than
less than	greater than	equals



GOAL #3:
The student will be able to identify or write the sum of two one-place numbers.

PRE-ACTIVITY LEARNING: Pupils have learned addition facts for numbers less than 10 .

ACTIVITY #1 ..... **Drag Race**



MATERIALS:

Gameboard made with curving track. Each block of track has a number. Two piles of cards. One pile is numbered with one of the digits 1 through 9. The cards in the other pile bear special instructions; these are the pit stop cards.

Miniature racing cars of different colors

Addition table for checking

NUMBER OF PLAYERS:

Two to four players. All players should already be well acquainted with the addition table. One of the players should check all the answers on the table.

DIRECTIONS:

Each player selects a car. All cars are placed on the space labeled "Start." Each player, in turn, draws a card. He must add the number on that card to the number on the next spaces he lands upon. The number on the card corresponds to the number of spaces he moves. For example, if he draws a "2" card, and the next two blocks are marked "3" and "6", he would give the sum of 2 and 3 and the sum of 2 and 6.

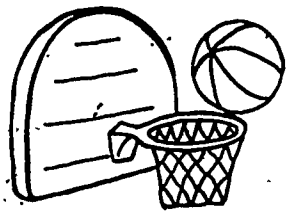
Certain blocks should be colored blue. If a player lands on one of these at the end of his move, on his next play he would draw a pit stop card. These cards would say something like "Out of gas—back 2" or "Speed up—move ahead 5".

If a player gives a wrong answer, he moves back to where he was at the beginning of his turn. The first one to reach the "Finish" space is the winner.

FOLLOW-UP:

The teacher should watch the game and be aware of which number facts are missed most often and by which children. He should offer drill in the number fact families, using concrete objects to add and count if necessary.

This game could be modified to drill on subtraction and multiplication facts if the teacher desires.



GOAL #4:
The student will be able to solve a one- to four-place addition problem without regrouping.

PRE-ACTIVITY LEARNING. The pupil should have mastered finding the sum of two one-place numbers.

ACTIVITY #1 ..... **Combo Math**

MATERIALS:

Sixty 3x5 inch cards

Two addends are written on half the cards, the answers are given on the other half. Every card with addends bears a number in the lower right corner. Answer Key.

NUMBER OF PLAYERS:

Two to four players

DIRECTIONS:

Shuffle all the cards. A dealer gives four cards to each player. The remaining cards are placed face down on the table. Before play begins, the players check their hands to see if they can match examples with answers. If they can, pairs are placed in front of players. The first player draws a card from the deck. If he can, he lays down an example-answer pair. He then discards a card face up next to the deck which is face down. The second player draws from the top of the discard pile (but only if he can use it on that play) or from the face down deck. He proceeds as the first player, and the play passes to each in turn.

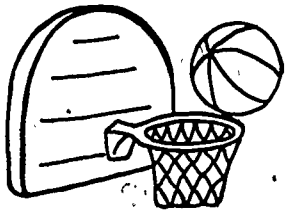
A player who has laid down all his cards must pick up four more cards before the next player takes his turn.

The player to lay down the most pairs wins.

FOLLOW-UP:

The game can be lengthened or shortened by varying the number of cards in the deck. The difficulty may be increased or lessened by increasing or decreasing the number of digits in the addends.

The players can check themselves using the key, but it would be of value to have the teacher notice the speed and accuracy of the players. He should observe which number facts give the most trouble so that reinforcing drills and activities can be developed.



GOAL #5:
The student will be able to solve a one- to four-place addition problem with regrouping.

PRE-ACTIVITY LEARNING. Pupils have learned to add with regrouping. Cumulative addition should be a familiar concept or should at least be explained at the onset of the game.

ACTIVITY #1 ..... **Ladybug Cubes**

MATERIALS:

A pair of cubes. Each cube has a ladybug on one face. The other faces are labeled one of the digits 0 through 9.

Scoresheet and pencil for each player

NUMBER OF PLAYERS:

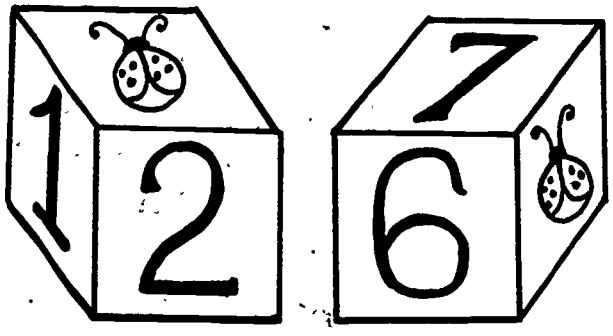
One to four players

DIRECTIONS:

Each player starts with a score of zero on his sheet. The first player rolls the cubes and adds the numbers appearing on the two tops. This sum is added to his score sheet. He keeps rolling the cubes until one bug appears on top of a cube. Then he must pass the cubes to the next player, retaining his cumulated score. If two bugs appear on top, the player's score is set at zero, and he must begin again to accumulate a score. He passes the cubes to the next player. Each one plays in turn, as outlined for the first player.
The first player to reach 100 points wins.

FOLLOW-UP:

The teacher should check the scoresheets to see if there are any mistakes in addition. He may wish to modify the total required for winning or the size of the numbers on the cubes.



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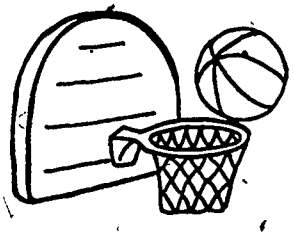
GOAL #6:
The student will be able to identify or write the solution to a word problem which involves addition of one- to four-place whole numbers with regrouping.

EXERCISE #1. Lucy sold 69 eggs last week and 75 eggs this week. How many eggs did she sell during the two weeks?

EXERCISE #2. John went on a boy scout hike. He hiked 9 miles on Saturday and 5 miles on Sunday. What was the total number of miles he hiked?

EXERCISE #3. Betty went bowling with her brother Scott. Betty's scores were 80, 85, 92. Scott's scores were 83, 82, 90. Who has the higher total score?

EXERCISE #4. Tom and Sally went on a vacation trip. They drove 3,284 miles all the way across the country. They did not come straight home, so their return trip was 3,897 miles. What was the total number of miles they traveled?



GOAL #7:
The student will be able to identify or write the difference of a one- or two-place number where the two-place number is less than 19.

PRE-ACTIVITY LEARNING. Pupils have learned the concept of subtraction and have already had some practice with number facts where the resulting answer does not exceed 20.

ACTIVITY #1 ..... **Spin It**

MATERIALS:

A circle drawn on tagboard. Diameters are drawn every 18°, forming 20 wedge-shaped pieces. The numbers 1 through 20 are placed in random order on these wedges. A spinner is attached to the center of the circle.

A sheet of paper and pencil are assigned to each child.

NUMBER OF PLAYERS:

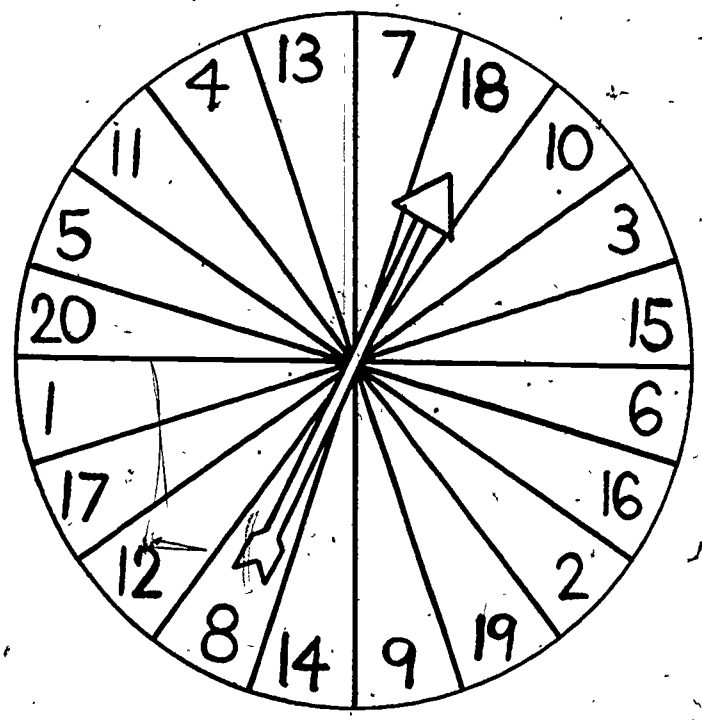
For minimum "out" time, the number of players should not exceed three.

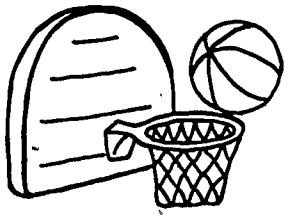
DIRECTIONS:

The children put their names on the sheets of paper. The first player spins the spinner and records the numbers pointed to by both ends of the spinner. He subtracts the smaller number from the larger one and writes the answer. The children take turns and the game is over after each one has had four turns.

FOLLOW-UP:

The teacher should look at each child's sheet to see what types of errors were made. He should be liberal with praise for correct answers and should provide reinforcing activities where needed.





GOAL #8:
The student will be able to solve a one- to four-place subtraction problem without regrouping.

PRE-ACTIVITY LEARNING. Pupils have learned one- to four-place substraction where no regrouping is required.

ACTIVITY #1 ..... **$100 Champion**

MATERIALS:

Play money in denominations of $1, $5, $10, $20

Four boxes labeled 1, 2, 3, 4

Cards with subtraction problems. One-place problems are in box 1; two-place problems are in box 2, etc. Cards bear identification numbers in lower right corner.

Answer key

Paper and pencil for each child

NUMBER OF PLAYERS:

Three or four. One player is designated the banker.

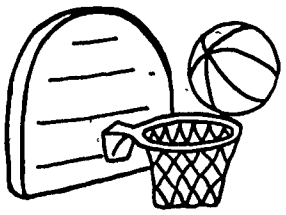
DIRECTIONS:

The first player picks the top card from any one of the four boxes. He records the answer and shows it to the banker. The banker checks the answer in the key. If the answer is correct, he gives the player $1 for an example from box 1, $5 for one from box 2, $10 for one from box 3, and $20 for one from box 4. No money is given for an incorrect answer.

Play passes to each child in turn and continues until one child has accumulated $100. He is the $100 champion.

FOLLOW-UP:

The teacher should check the children's written work and discuss any difficulties they might have had. This game could be adapted to other operations as well.



GOAL #9:
The student will be able to solve a one- to four-place subtraction problem with regrouping.

PRE-ACTIVITY LEARNING: Pupils have learned the concept of regrouping. They have already had some drill in this skill.

ACTIVITY #1 ..... **Regrouping Bingo**

MATERIALS:

Subtraction problems on a loose-leaf ring. An identification number is placed on the back of each problem. Nine square bingo cards which have been laminated

Container holding markers

Pencil and paper for each child

Answer key

NUMBER OF PLAYERS:

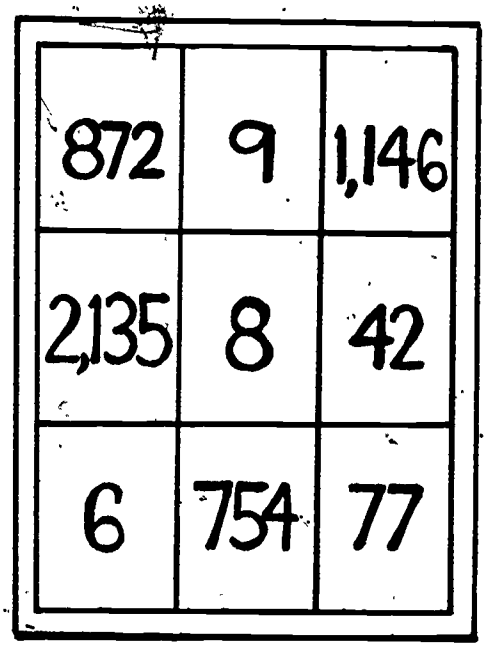
One to six players. If more than one child is playing, one player might act as the caller and read aloud the example.

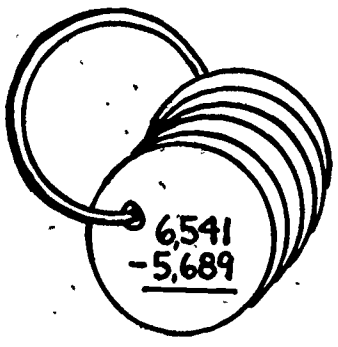
DIRECTIONS:

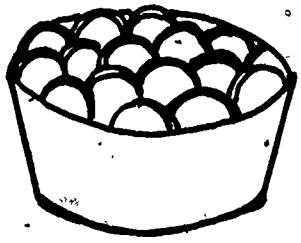
Each pupil participating chooses a bingo card. The players work the examples in the order they appear on the loose-leaf ring. If the answer is on the child's bingo card, he places a marker on the proper place. When he has three answers in a row, column, or diagonal, he checks his answers on the key. If they are correct, he receives a small prize or privilege from the teacher.

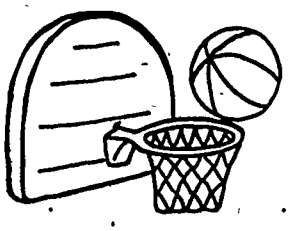
FOLLOW-UP:

The teacher should check the work the child did to arrive at his answers. He should question the child on one or two of the examples to make sure he understood the regrouping procedure.







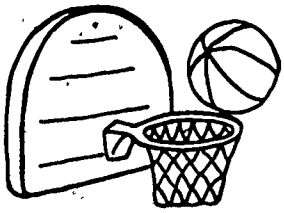


GOAL #10:
The student will be able to identify or write the solution to a word problem which involves subtraction of one- to four-place whole numbers with regrouping.

EXERCISE #1: Jack had 11 goldfish. Nine are small. The other goldfish are large.

EXERCISE #2. My mother bought 250 stamps for Christmas cards. After she mailed all of the cards, she had 60 stamps left. How many cards did she mail?

EXERCISE #3: Mr. Smith bought a car for $3,800. A year later he sold it to Mr. Jones for $2,900. How much less did Mr. Jones pay for the car than did Mr. Smith?



GOAL #11:
The student will be able to identify or write the product of any two one-place numbers.

PRE-ACTIVITY LEARNING. The pupils understand the concept of multiplication and have already had some drill.

ACTIVITY #1 ..... **Beans, Beans**

MATERIALS:

Poster board, divided into squares as shown. Numbers 1-9 are written at random on the squares.

Small can

Two large lima beans

Multiplication table

NUMBER OF PLAYERS:

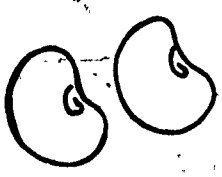
Two to four players. One player also might check the answers, using the multiplication table.

DIRECTIONS:

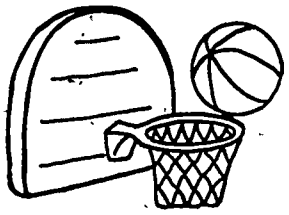
Players take turns tossing the beans onto the board. The player must give the product of the two numbers on which the beans land. A point is given for each correct response. The player with the most points at the end of the game is the winner.

FOLLOW-UP:

A teacher should watch, at least at intervals, so that he can see which products are the most troublesome. Additional activities could be based on these particular products.



7	3	4	5
9	1	7	6
4	6	8	2
8	9	3	5



GOAL #11:
The student will be able to identify or write the product of any two one-place numbers.

ACTIVITY #2 ..... **The Old Multiplier**

MATERIALS:

26 sets of two cards each, each set showing one equation and one product

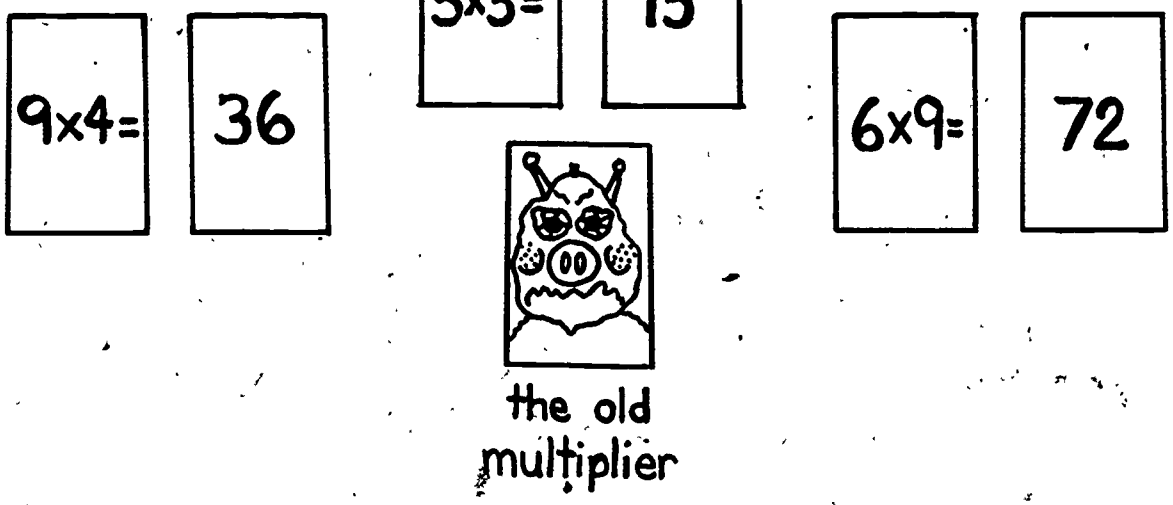
Old Multiplier card

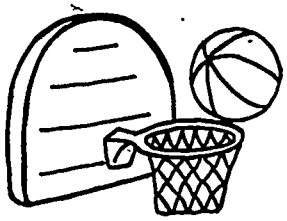
NUMBER OF PLAYERS:

Three to five players

DIRECTIONS:

This game is played according to Old Maid rules. The object is to match each equation with its product. The player left with the Old Multiplier is the loser.





GOAL #11:
The student will be able to identify or write the product of any two one-place numbers.

ACTIVITY #3 ..... **Smiling Sunflower**

MATERIALS:

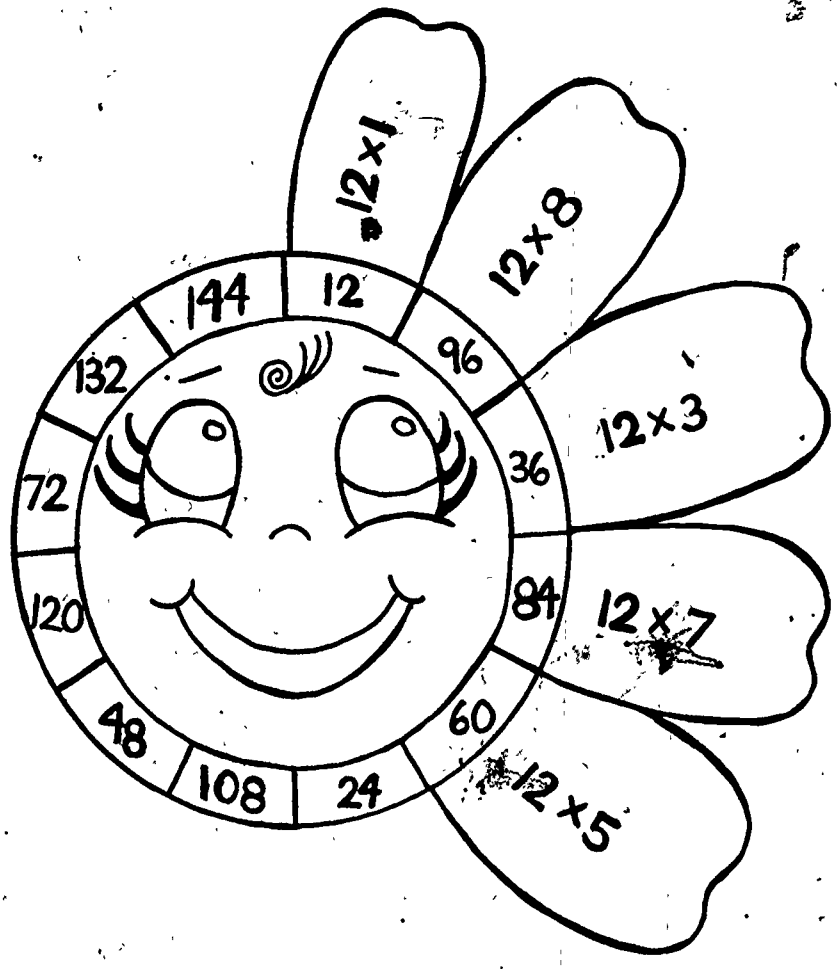
Large sunflower face is cut out of tagboard. Multiples of some factor, such as 12, are written around the circumference of the flower. Petals are cut out in a size appropriate to the flower. Two factors, one of them being held constant, are written on each petal.

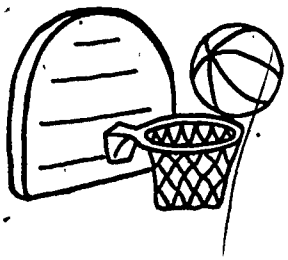
DIRECTIONS:

The pupil places the petals next to the corresponding correct answers to form a smiling sunflower. The teacher checks the placement of the petals.

FOLLOW-UP:

The teacher may wish to have pupils assist in constructing sunflowers for other multiplication tables.





GOAL #11:
The student will be able to identify or write the product of any two one-place numbers.

ACTIVITY #4 ..... **Who Lives Here?**

MATERIALS:

Three or more houses are put on the bulletin board, perhaps against a colorful landscape. Clipped to the roofs are numbers such as 42, 36, 63.

Product cards such as 4x9, 7x6, 9x7 are prepared.

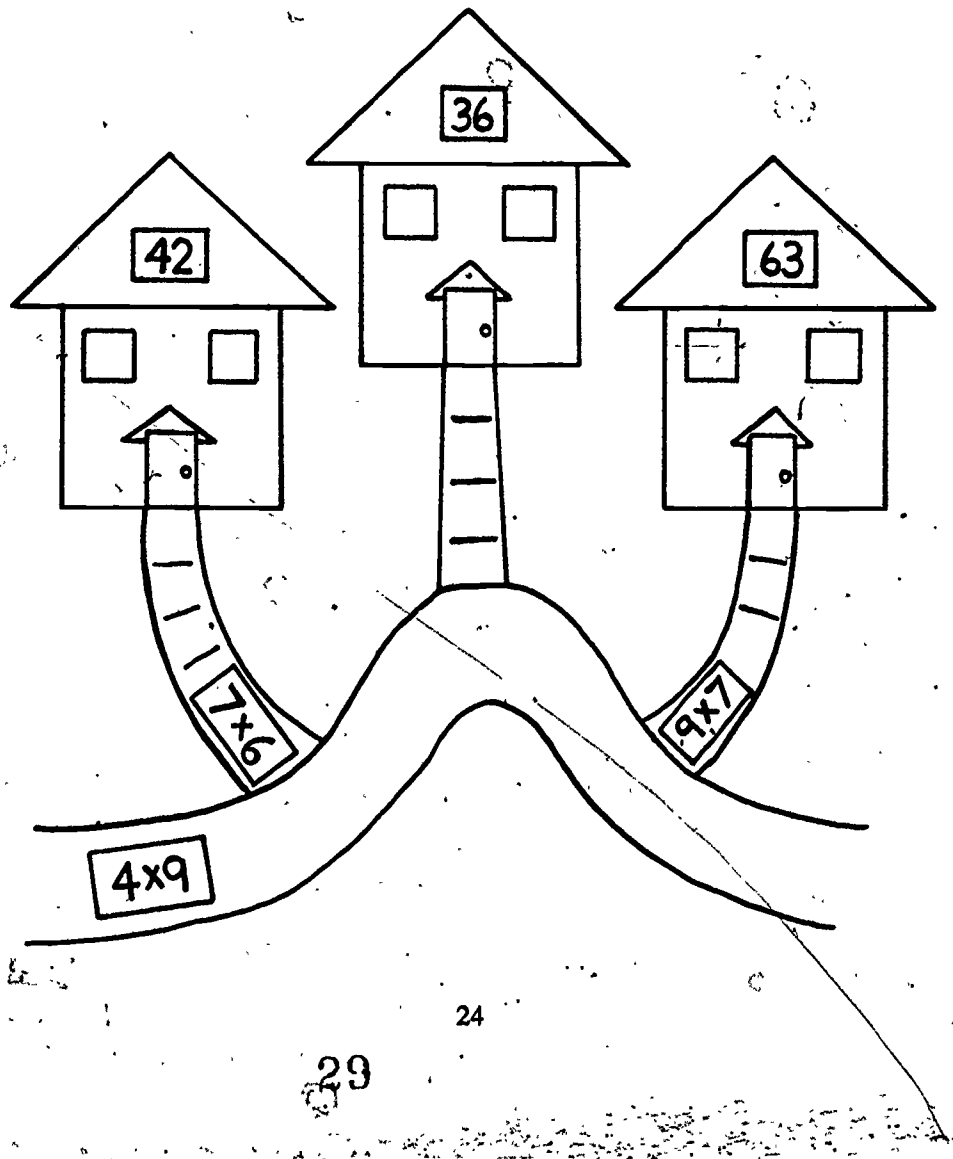
DIRECTIONS:

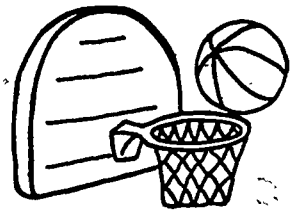
The pupil is to put the product cards on the path that leads to the house with the correct answer.

FOLLOW-UP:

The teacher should check the placement of the cards and give more related activities to those requiring them.

The teacher will want to vary the numbers clipped to the roofs after one set of number facts has been mastered.

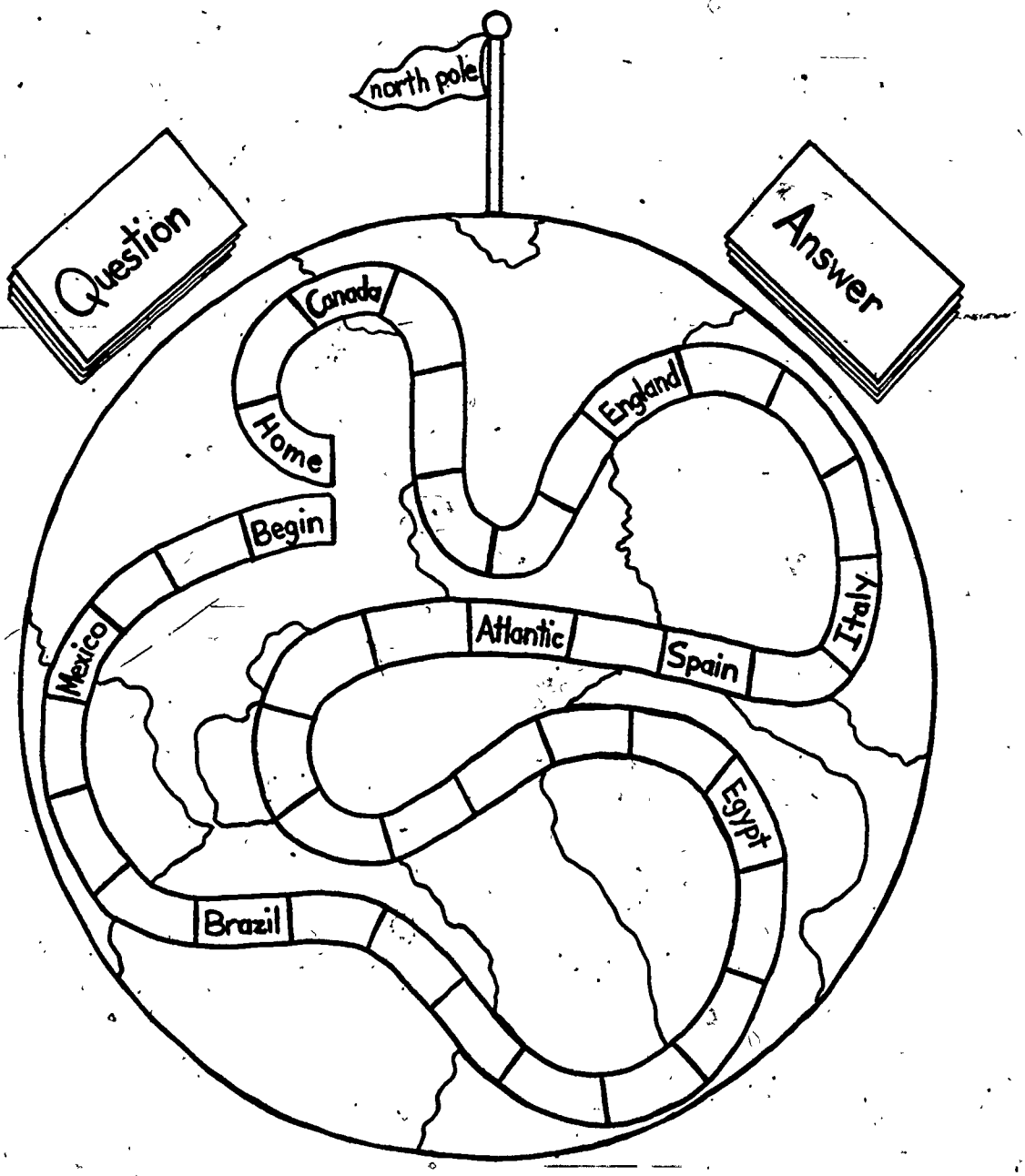




GOAL #12:
The student will be able to identify or write the product of a one-place factor times a two-, three-, or four-place factor without regrouping.

PRE-ACTIVITY LEARNING: The pupil has learned to multiply a one-digit number by a factor having up to four places, where no regrouping is required.

ACTIVITY #1 ..... **Around the World**



MATERIALS:

Playing board having spaces marked with names of countries or oceans.

Question cards and answer cards, both marked with corresponding numbers from 1-50 in the lower right corner. Question cards are products of one-place factors and two- to four-place factors.

Different colored cards or other markers

Pencil and paper for each player

NUMBER OF PLAYERS:

One to four players

DIRECTIONS:

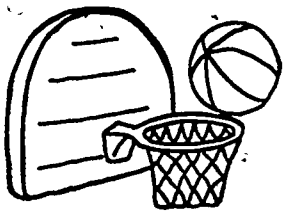
At the beginning of the game the question and answer cards are face down on the board. They are arranged in sequential order. Each person's marker rests on the BEGIN space.

One person starts the game by taking the top question card. He answers orally or figures out the answer with pencil and paper. He checks himself with the answer card from the top of the answer pile. If he is correct, he moves his marker forward five spaces. If he is wrong, he moves backward one space, unless he is on BEGIN in which case he does not move. If he lands on a sea or an ocean, he loses his next turn.

Each person plays in turn, and the first one to go around the board, reaching HOME, wins.

FOLLOW-UP:

The teacher should check to determine which problems are presenting the greatest difficulty. Are the children most troubled with a particular table, such as the seven table? Are the hardest problems those with four-place factors? Additional drill in these areas may be desirable.



GOAL #13:
The student will be able to identify or write the product of a two-place factor times a two-, three-, or four-place factor with regrouping.

PRE-ACTIVITY LEARNING: The pupil has learned the concept of regrouping in multiplication. He also understands that the operation of addition with regrouping is a part of the procedure when the multiplier is a two-, three-, or four-place factor.

ACTIVITY #1 ..... Am I Really That Old?

Exercise 1: Multiply your age in years by 12. The answer is your age in months on your last birthday.

Exercise 2: Add 1 to your age. Multiply the result by 365. The answer is your age in days on your next birthday.

FOLLOW-UP:

The teacher should collect the work of the pupils and correct it. He should discuss mistakes with the child and give him additional drill on those number facts where he is weak.

GOAL #14:
The student will be able to divide a one- to four-place number by a one-place divisor and identify or write the quotient without a remainder.

PRE-ACTIVITY LEARNING. The pupil has mastered his multiplication tables as well as subtraction facts. He understands the basic concept of division.

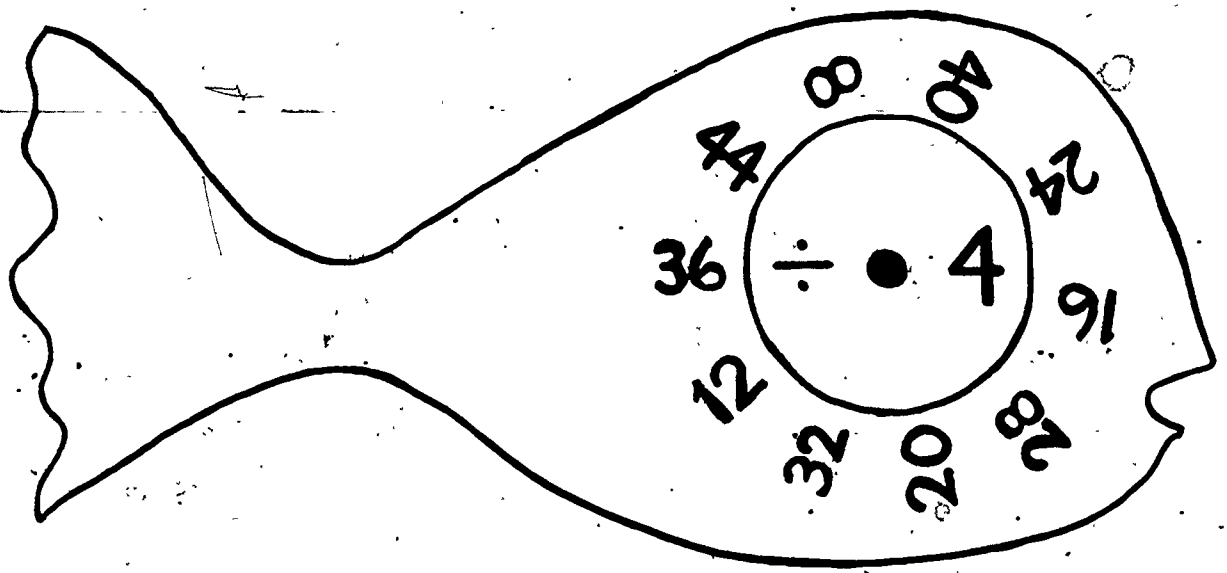
ACTIVITY #1 ..... **Fish for the Quotient**

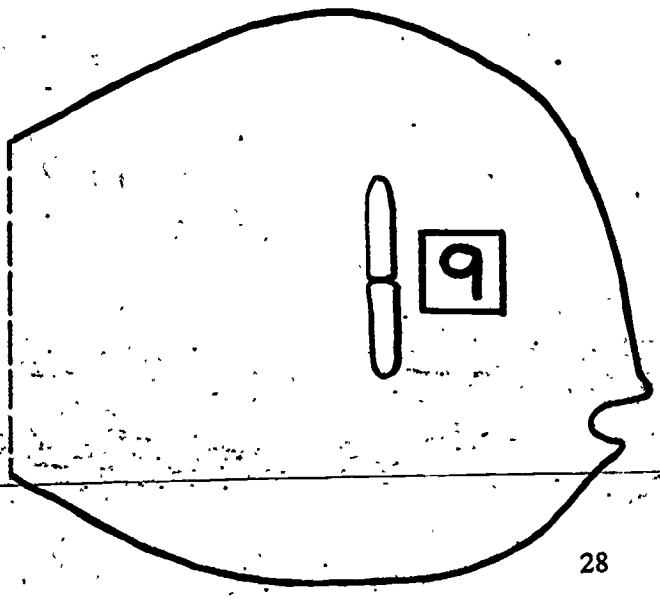
MATERIALS:

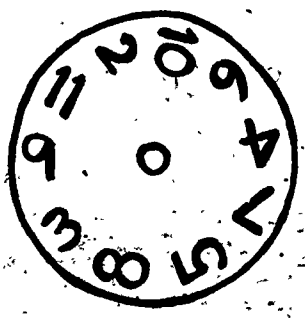
The teacher constructs one cardboard fish for each different divisor.

A circle is attached to the fish with a brad. On the circle are printed the divisor and the symbol ÷. Outside of and adjacent to the circle are printed the dividends.

A square hole is cut in the underside of the fish. The hole exposes the answer, written on the back of the circle, to the division example lined up on the top of the fish. (See top and bottom views of the fish.)







NUMBER OF PLAYERS:

This is an individual activity.

DIRECTIONS:

The appropriate fish is given to a pupil. For example, let the pupil use a divisor 4 fish. He lines up the ÷ with any number on the fish. If he lines up the 8 with the ÷, he would check himself by turning the fish over to expose the number 2. The pupil tests himself with every different possible position of the ÷.

FOLLOW-UP:

The teacher should check with the pupil to see if he is experiencing any difficulty. If he is, he may need more drill in the multiplication facts.

GOAL #15:
The student will be able to divide a one- to four-place number by a one-place divisor and identify or write the quotient with a remainder.

PRE-ACTIVITY LEARNING. The pupil has mastered subtraction and multiplication. He has learned that the dividend is equal to the remainder plus the product of the divisor and the quotient.

ACTIVITY #1 ..... What's Your Remainder?

MATERIALS:

Dividends are written on 5x8 inch cards. They are written in large dark print so that they can be read easily at a distance.

Divisors for use of teacher

Box for dividends

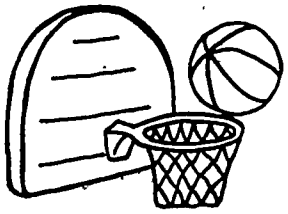
DIRECTIONS:

The teacher puts the dividend cards in a box which is then passed among the group. Each pupil takes two cards.

The teacher takes one of his divisors, for example 5. He then says "If you have a number which can be divided by 5 without a remainder, hold up your card." Those pupils having such cards hold them up so the teacher can see them. The teacher gives out praise and encouragement after which the pupils put the cards back on their desks. The teacher rephrases his question, asking for a remainder of 1, 2, or any number he desires. The teacher calls out other divisors and remainders in like manner for a time not to exceed the attention span of the pupils.

FOLLOW-UP:

The teacher should be able to notice whether mistakes are due to lack of multiplication or subtraction skills, and will assign other activities to strengthen the deficient skill.



GOAL #16:
The student will be able to identify or write the fraction which represents the shaded area of a diagram.

PRE-ACTIVITY LEARNING. The pupil has learned the concept of parts which comprise a whole. He already will have had some drill in this type of activity.

ACTIVITY #1 ..... **Spin and Say**

MATERIALS:

Large piece of tagboard illustrated to correspond to attached drawing

Sectors are numbered for checking.

A spinner is attached with a brass brad to the center.

Key

NUMBER OF PLAYERS:

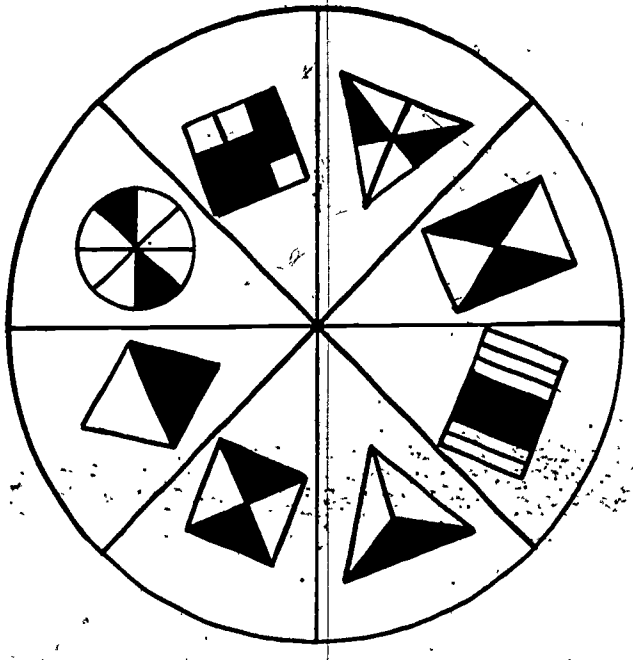
Two to four players. One of the players could be the "judge." He would verify the response, using the key.

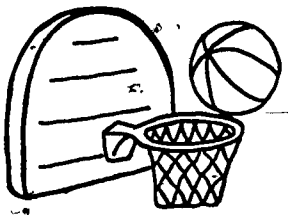
DIRECTIONS:

The pupils take turns spinning the spinner and naming the ratio of the shaded area to the whole (i.e., the fraction.) The "judge" checks to see if they are right. Players are given one point for each correct response. The game ends when one person has accumulated seven points. He is named the spinner wing-ding.

FOLLOW-UP:

This activity may be used in conjunction with the corollary to goal #16. These two activities must be mastered before the pupil attempts any operational problems with fractions.





COROLLARY TO GOAL #16:
Given a fraction, the student can display it using pre-cut shapes or pegboards or shaded parts of a diagram.

PRE-ACTIVITY LEARNING: The pupil has learned that a fraction is the representation of a part compared to the whole.

ACTIVITY ..... **Chase the Pig**

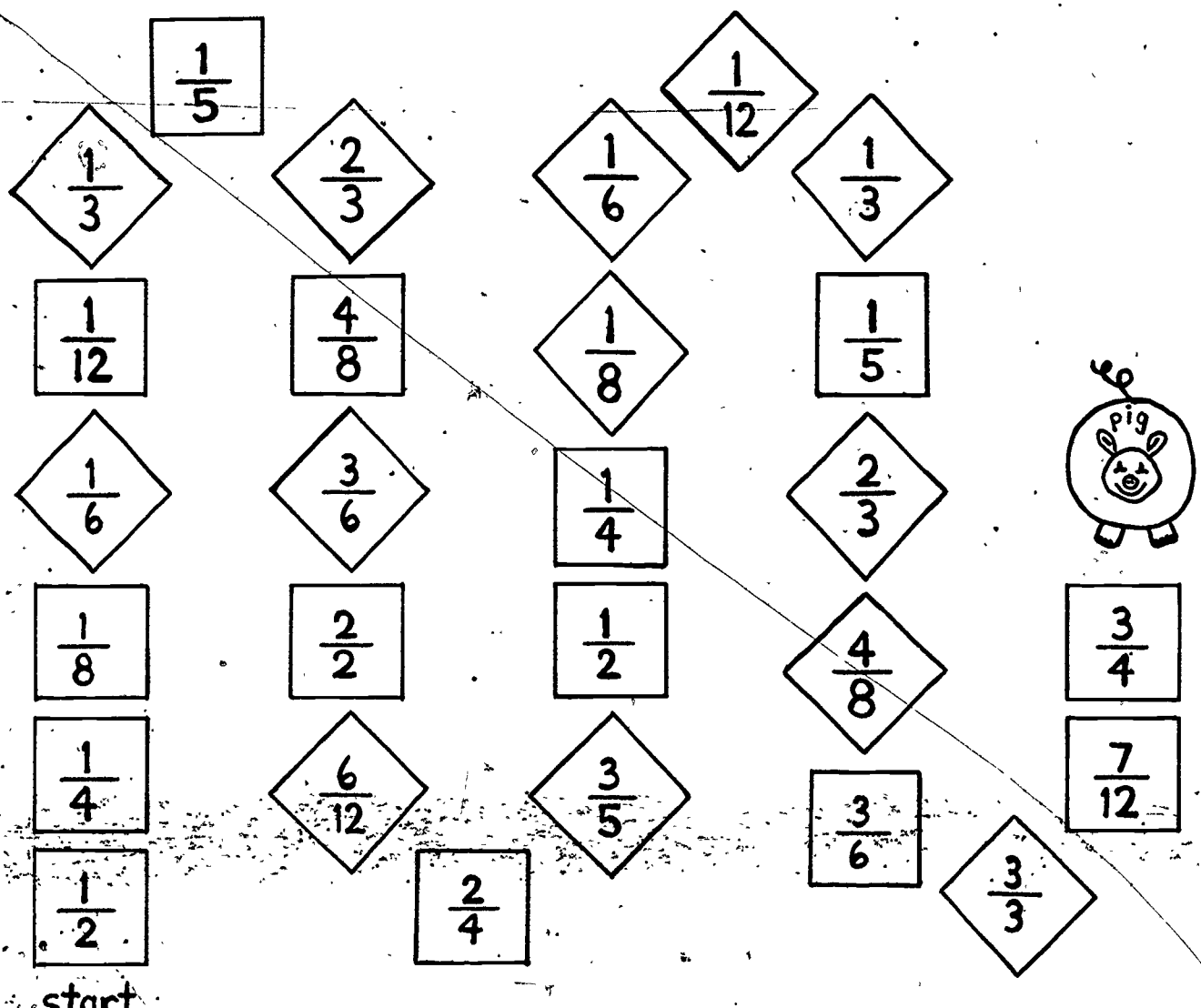
MATERIALS:

Game board

Markers

Spinner or dice

Pegboard, geoboard, pre-cut shapes as decided by the teacher



NUMBER OF PLAYERS:

In addition to three or four players, the presence of a teacher or other adult is required.

DIRECTIONS:

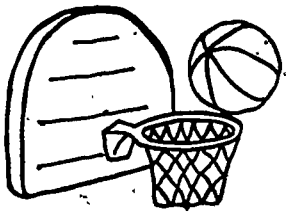
The teacher determines in advance in what manner the pupil is going to express the fractions on the gameboard. The alternatives would include pegboards, geoboards, pre-cut pieces, shaded areas.

Using a spinner or dice to determine the number of moves in a given turn, the players move alternately, beginning from "Start." When a player lands on a space, he says the fraction and makes a representation of that fraction in the form specified by the teacher. The teacher checks the pupil's display before the next pupil takes his turn.

The first player to arrive at "PIG" is the winner.

FOLLOW-UP:

This would be a good tool for diagnosis. The teacher can judge from the pupil's hesitation or speed whether he really understands the meaning of a fraction. The teacher should devise other similar activities for those pupils exhibiting low comprehension. This skill is basic to all other work in fractions, and its importance to building a foundation cannot be overemphasized.



GOAL #17:
The student will be able to identify or write the sum of fractional numbers with like denominators.

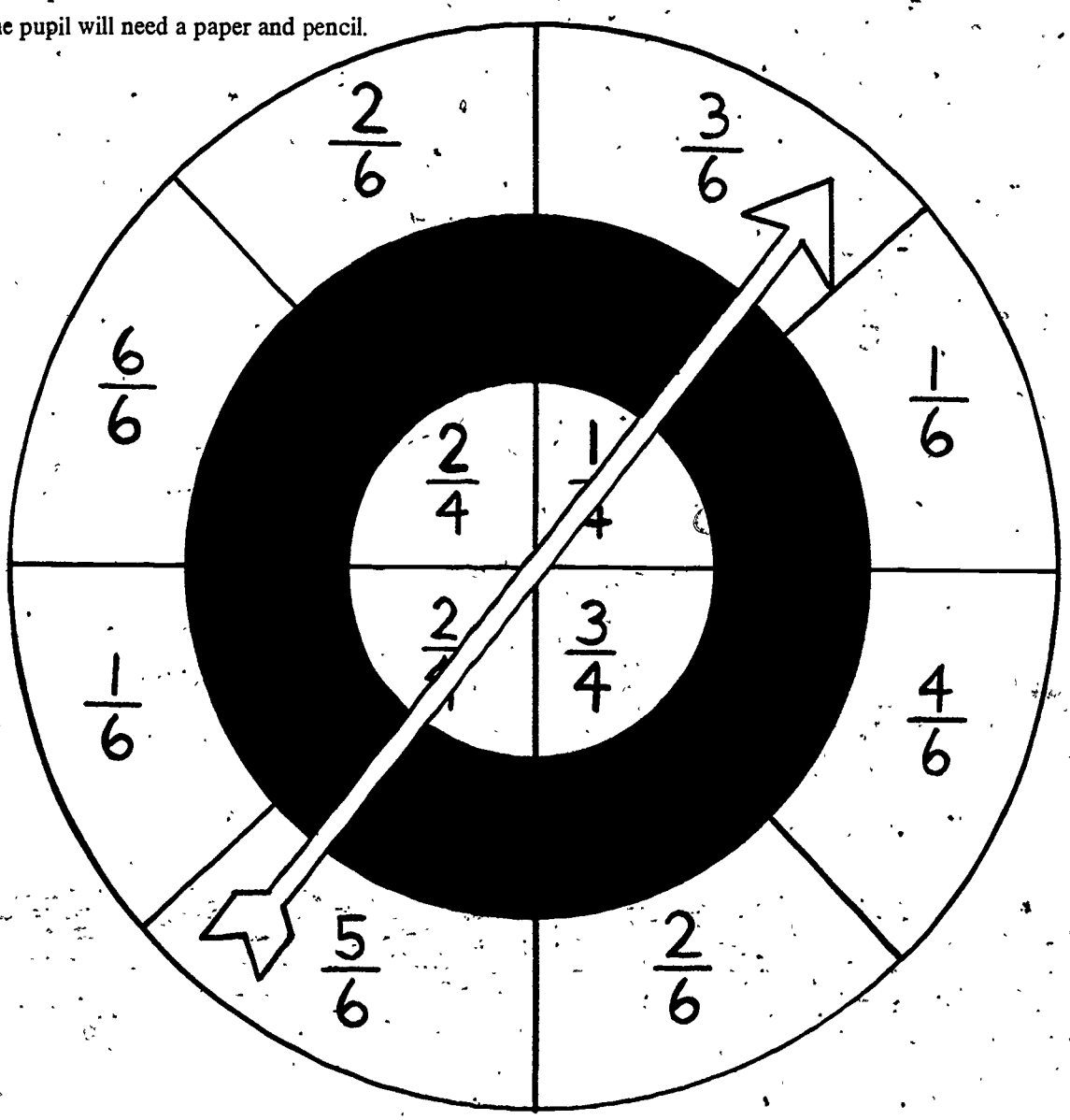
PRE-ACTIVITY LEARNING. The pupil has learned that he can add like quantities. This is just as true for halves, thirds, fourths, etc. as it is for apples, dollars, and eggs. The following activity is for drill and reinforcement of this idea.

ACTIVITY #1 ..... **Where She Stops, Nobody Knows!**

MATERIALS:

Board prepared with three concentric circles. Fractions are written in the spaces, and segments are shaded as in the accompanying illustration. Denominators within any one ring must be consistent. A spinner is attached to the center of the board.

The pupil will need a paper and pencil.



NUMBER OF PLAYERS:

This is meant to be an individualized activity, although it can be adapted to two or three players.

DIRECTIONS:

The pupil spins the spinner. He records the fractions in the segments of the outermost ring which are touched by the spinner. He finds the sum of these two fractions. This is done in the usual manner so that the addends appear one under the other, with a line separating them from the total. He does this three more times.

The pupil repeats the above procedure in the other ring and in the inmost center. He shows his work to the teacher for evaluation.

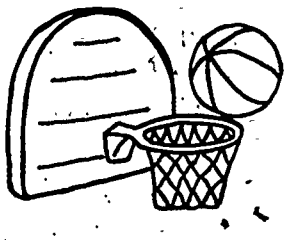
FOLLOW-UP:

If this exercise presents difficulty to the pupil, there could be two explanations:

1) He does not know his basic addition facts.

2) He does not grasp the elementary concept of adding like quantities.

The teacher should be able to supply additional activities for drill that would develop these skills.



GOAL #18:
The student will be able to identify or write the sum of an addition problem of mixed numbers with like denominators.

PRE-ACTIVITY LEARNING. The pupil has mastered the addition of both whole numbers and fractional numbers with like denominators.

ACTIVITY #1 ..... **Magic Squares**

MATERIALS:

Magic squares constructed so that the numbers are either whole numbers or mixed numbers with like denominators. In adding the numbers in a line, the sum of the fractional parts should be less than one.

The pupil will need pencil and paper.

NUMBER OF PLAYERS:

This is an individual activity, however, several pupils can work on different magic squares at the same time.

DIRECTIONS:

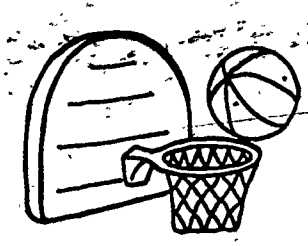
The pupil adds the numbers in each row, column, and diagonal. The answer should be the same in each instance. The pupil should show his work to the teacher.

FOLLOW-UP:

If the pupil experiences difficulty with this activity, it is a sign that he is weak in basic addition facts. The pupil should be given other activities to assist him in this skill.

If the pupil finds this a very easy exercise, the teacher may develop the exercise with an additional step and introduce improper fractions. The pupil could then play a more advanced form of the magic squares game.

$4\frac{6}{10}$	$3\frac{9}{10}$	$4\frac{4}{10}$
$4\frac{1}{10}$	$4\frac{3}{10}$	$4\frac{5}{10}$
$4\frac{2}{10}$	$4\frac{7}{10}$	4



GOAL #19:
The student will be able to identify or write the difference in a given subtraction problem of like fractions less than one.

PRE-ACTIVITY LEARNING: The pupil has learned to add and subtract fractional numbers with like denominators. In particular, he understands that n n-ths (two halves, three thirds, four fourths, etc.) make a whole or one.

ACTIVITY #1 ..... **Dominoes**

MATERIALS:

Three dozen dominoes constructed so that each end is a proper fraction.

They should be made of cards.

NUMBER OF PLAYERS:

Two to four players

DIRECTIONS:

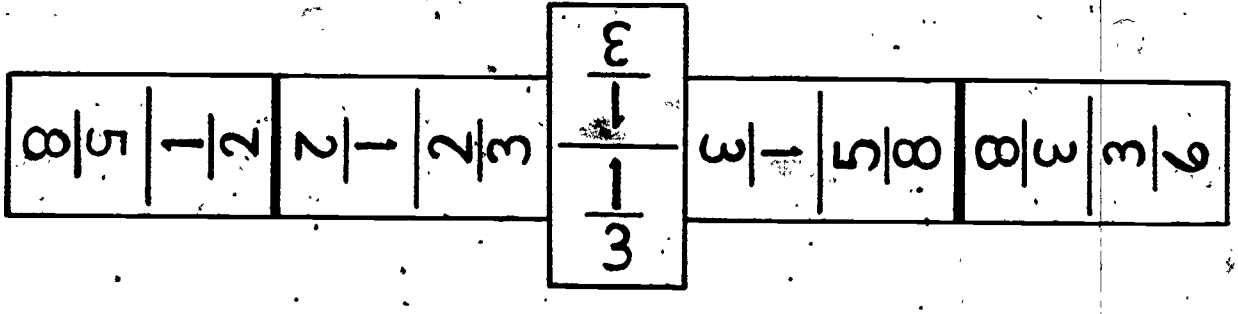
This game is played like the usual game of dominoes modified so that the fractions placed together must add up to 1. The play alternates and the first one to use up all his dominoes is the winner.

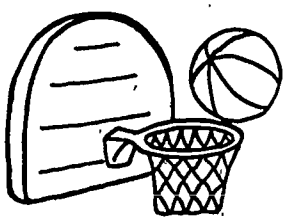
Once the game is ended, the teacher should check it to see if the dominoes have been placed according to the rule.

FOLLOW-UP:

If the pupils find this a laborious game, the teacher needs to go back over the basic concept of fractions and provide additional activities in support of goal #16. The pupil should be given opportunities to divide shapes into N (n = 2, 3, 4, etc.) equal parts. Let him count the parts. Listen to him say, "I have divided this circle (or any other shape) into two halves (three-thirds, or four-fourths, etc.)."

The teacher might point out that two halves make a dollar, that four quarters make a dollar. He might also fill a measuring cup with water, having the children count how many third-cups and fourth-cups it takes.





GOAL #20:
The student will be able to identify or write the difference in a given subtraction problem of mixed numbers with like denominators.

PRE-ACTIVITY LEARNING. The pupil has mastered subtraction of whole numbers and subtraction of fractions with like denominators.

ACTIVITY #1 ..... High Tower, Low Tower

MATERIALS:

Six cans or oatmeal boxes of different heights are nailed to a board. White or pastel-colored papers are wrapped around each can and secured in place.

On each paper is written a mixed fraction. All of the mixed fractions have like denominators. The larger fractions appear on the larger cans.

Two small pin cushions or bean bags which will easily fit into the cans or boxes

Pencil and paper for each player

NUMBER OF PLAYERS:

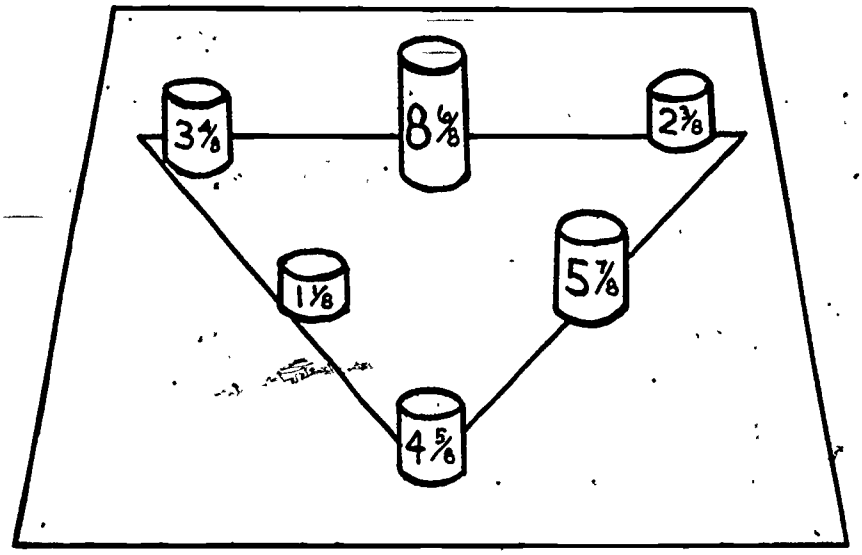
Two to four players

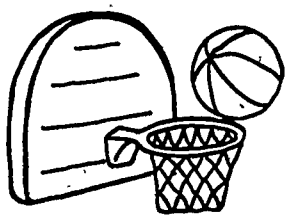
DIRECTIONS:

Place the board on the floor. Participants stand behind a line about five feet away. Players take turns throwing the two bags, one at a time, into the cans. The player tries again if he misses. The pupil records the two mixed fractions from the cans into which he threw his bags, writing the smaller under the larger one. He makes the subtraction. After each person has had four turns, the teacher looks at the pupils' work.

FOLLOW-UP:

The teacher might want to vary the game by changing the labels on the cans. Additional drill on basic subtraction facts would be desirable for those pupils making mistakes in this game.





GOAL #21:
The student will be able to identify or write the product of a whole number and a fractional number without simplifying the product.

PRE-ACTIVITY LEARNING: The pupil understands the concept of multiplication. He has learned that not only can he speak of 5 ones or 6 twos, but he can also speak of 5 thirds and 6 three-fifths.

ACTIVITY #1 ..... **Slice the Pies**

MATERIALS:

Pies (circles) are cut into two, three, four, and five equal slices. There should be two pies of the same number of slices, i.e., two pies are cut into halves, two into thirds, etc. It would be helpful if the different fractions were labeled and colored differently.

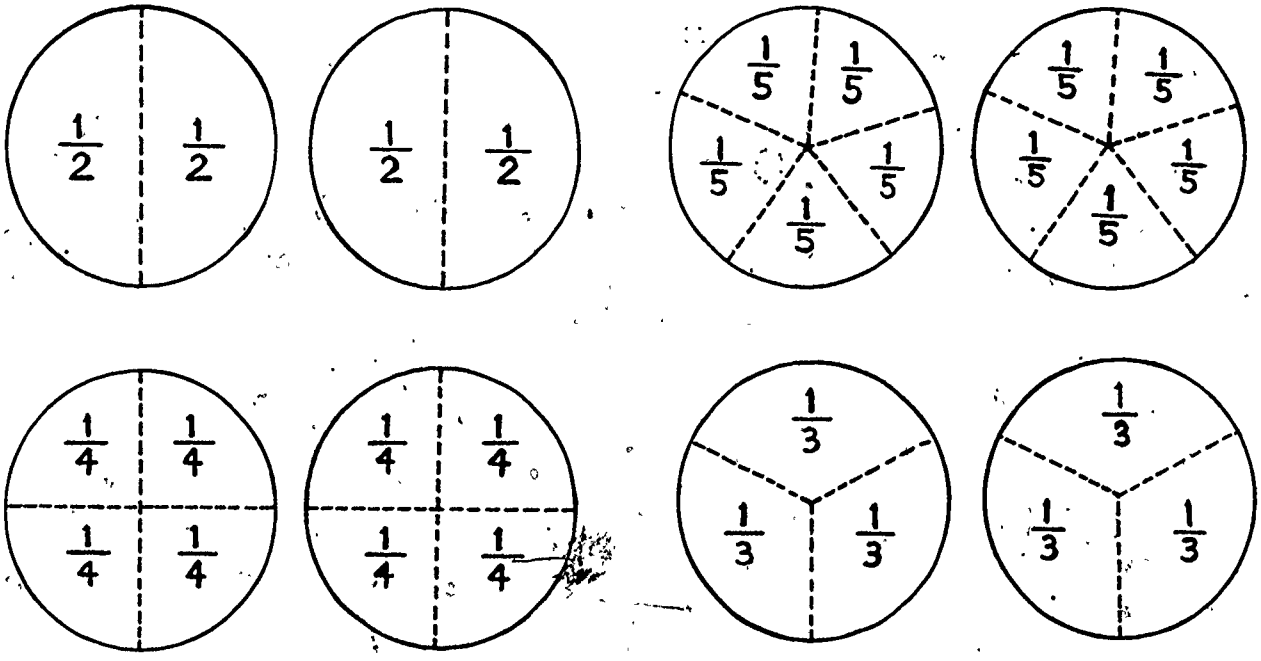
Fractional parts of the same size and color are placed together in a large manila envelope. Hence, four envelopes are required. They are labeled "halves," "thirds," "fourths," and "fifths."

Large paper plates the size of pie tins are also provided. They are stored in yet another envelope.

Examples such as $2 \times \frac{1}{3}$ (no product to exceed 2) are written on cardboard pieces shaped like dessert forks. They are kept in a long white envelope.

NUMBER OF PLAYERS:

This is an individualized activity, but it could be modified for two or three pupils.



DIRECTIONS:

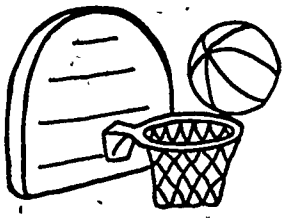
The pupil empties all of the manila envelopes and forms eight pies (or more at the discretion of the teacher).

The envelope holding the dessert forks is given to the pupil. He is told to draw a fork from the envelope and to take as many fractional parts as designated. These he is to put on a paper plate along with the fork. The pupil repeats the procedure, taking a different dessert fork and paper plate each time. After he has done this five to eight times, he should show his work to the teacher.

FOLLOW-UP:

The pupil's hesitation or mistakes might arise from his confusion relative to the different sizes of fractions. He may not distinguish thirds from fourths, for example. Or, mistakes might arise from his inability to comprehend an improper fraction. He may be so concerned with the value of the whole (one-ness) that he cannot grasp the idea of a fraction such as 7/5 or 5/4.

These problem areas should be anticipated by the teacher. He should be prepared to give additional explanations and activities.



GOAL #22:
The student will be able to identify or write the product of two fractional numbers less than one.

PRE-ACTIVITY LEARNING: The pupil has learned to multiply two fractional numbers, each having a value less than one. To assist him in comprehension and self-checking, he should have been shown by visual display that the product is always less than either of the factors.

ACTIVITY #1 ..... Open the Window

MATERIALS:

Two circles are attached with a brass brad. On the exposed portion of the outside circle are written fractional multipliers. The answers are written on the large circle between the multiplier and the center of the circle. (see illustration). They are written in such a way that they line up with the square hole cut in the smaller circle on top.

Pencil and paper are required by the pupil.

NUMBER OF PLAYERS:

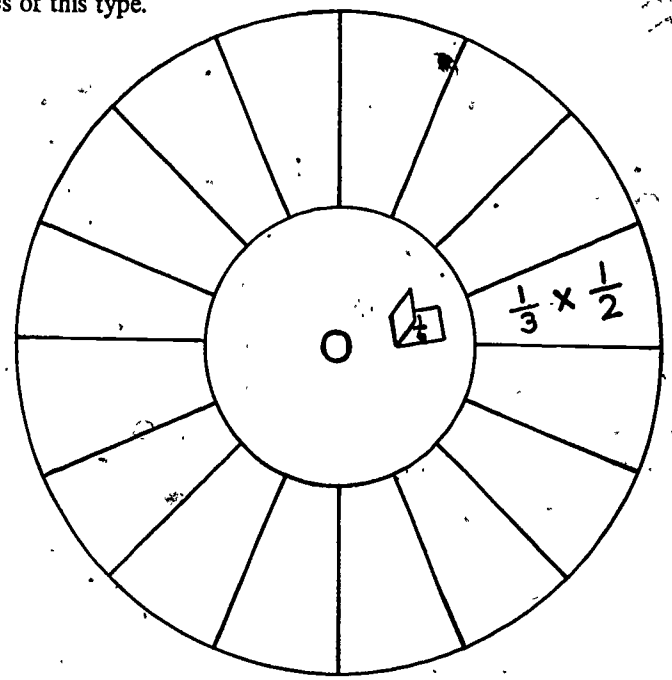
This is designed for one pupil, but two or three may play alternately.

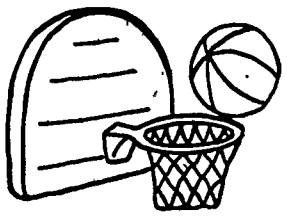
DIRECTIONS:

The pupil lines up the circles so that the window is next to any particular pair of multipliers. He writes the example and the product on his paper. Then he lifts the flap over the window to see if he has the correct answer. He repeats the procedure all around the wheel.

FOLLOW-UP:

The teacher should look at the pupil's work to see if he has correctly multiplied the two numerators and the two denominators. If he has not, the teacher should reteach the procedure for multiplying 2 fractions and then present other activities of this type.





GOAL #23:
The student will be able to identify or write the sum of an addition problem of mixed numbers with decimal fractions of tenths or hundredths with regrouping.

PRE-ACTIVITY LEARNING. The pupil has learned to read decimals and to add them once the demimal points have been aligned.

ACTIVITY #1 ..... Let's Buy Something!

MATERIALS:

Pencil and paper for each participant

Cards with decimal numbers such as $10.48, $5.68 etc. are divided equally into Deck A and Deck B. Desirable toys are pictured on individual cards of a third deck (deck C).

NUMBER OF PLAYERS:

Two to four players

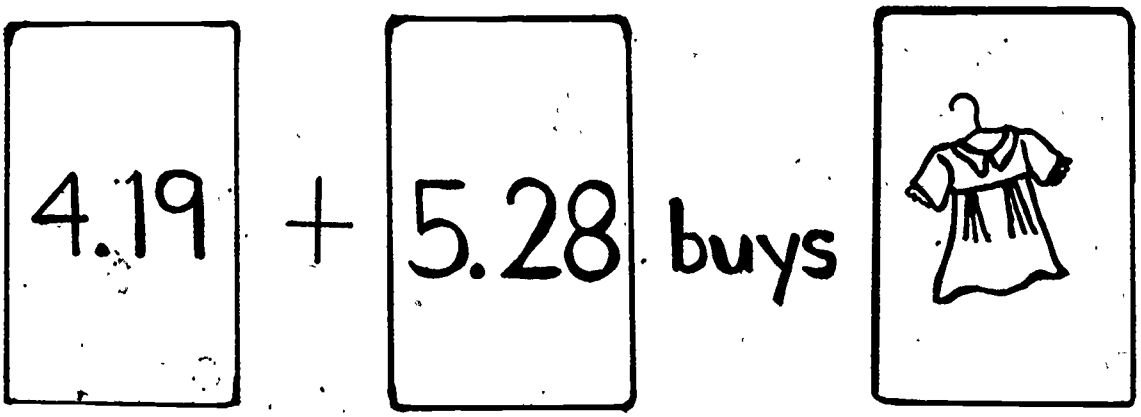
DIRECTIONS:

The first player draws the top cards from decks A and B in order to "buy" the top card from deck C. He writes down the two addends and the sum. Another player may challenge his answer, so actually all the players should do each sum. If the player whose turn it is goes unchallenged or has the correct answer, he keeps the cards. If he is proven wrong, the first one with the right answer gets the A, B, and C cards. Each player takes a turn until all the cards have been used. The one with the most cards is the winner.

FOLLOW-UP:

The teacher should check on the progress of the game to observe the kinds of difficulties the pupils are experiencing. The answers could be wrong for two reasons. First, the pupil's poor grasp of addition facts with regrouping; and second, the pupil's failure to line up the decimal points.

The teacher should provide more drill, if necessary, to overcome these deficiencies.



COROLLARY TO GOAL #23:
The student will be able to name decimal numbers and to compare them as to magnitude.

PRE-ACTIVITY LEARNING: The pupil has learned place value of numbers to the left and right of the decimal point. He will also have learned that .5, .50, .500 are equivalents.

ACTIVITY #2 ..... **Decimal Race**

MATERIALS:

A collection of large flash cards with three decimal fractions on each one

NUMBER OF PLAYERS:

Two teams of about 6 players each

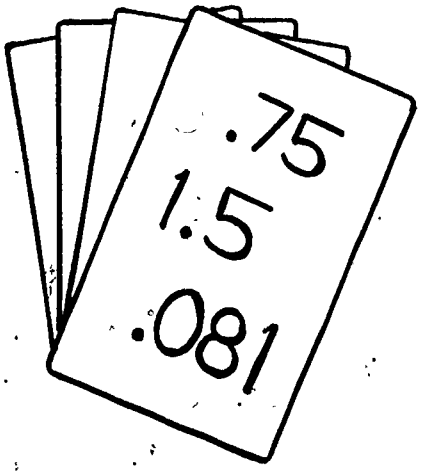
DIRECTIONS:

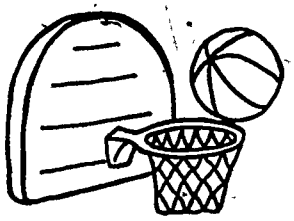
This game takes the form of a race. There are ten laps to the race, and the team that first answers 10 problems correctly wins the race and the game.

Teams supply individual contestants in rotation. If the contestant names all the decimal fractions and identifies the decimal that is the largest, his team advances one lap toward the goal of ten. If a contestant misses, the contestant of the opposing team has an opportunity to give the correct answer. If the second pupil misses, the first team has an opportunity to answer correctly, etc. This continues until the correct answer is given. Pupil leaders write the contestants' answers on the board; they draw an "X" through any incorrect answers. They also keep a record of the laps completed.

FOLLOW-UP:

The teacher notes the types of errors and engages the pupils in additional activities which stress these same skills. The skills of naming and ordering decimals are basic to all future operations of decimals; the teacher must give the time and drill necessary to the acquisition of these fundamental steps.





GOAL #24:
The student will be able to identify or write the difference of a subtraction problem of mixed numbers with decimal fractions of tenths and hundredths with regrouping.

PRE-ACTIVITY LEARNING: The pupil has learned to align the decimal point and subtract decimal fractions with regrouping.

ACTIVITY #1 ..... Have a Good Trip!

MATERIALS:

Play money
75 pennies
50 nickels
50 dimes
30 quarters
15 half-dollars
40 one-dollar bills
20 five-dollar bills
10 ten-dollar bills

Cards—7 groups, each naming something pertaining to a trip, such as:
Make Plans (colored white)
Take a Gift (colored light blue)
Buy a Ticket (colored pink)
To Entertain You on the Trip (colored pale purple)
Lunch Stop (colored yellow)
Souvenirs (colored pale orange)
Destination (colored pale green)

Within each group, the cards are numbered 1 through 6 as follows:

Make Plans
#1 Telephone Grandmother long distance. $1.75
#2 Write your cousin a letter. Cost of stamp, 10¢
#3 Send your aunt a telegram. $ .85
#4 Telephone your uncle—no answer. Try again on your next turn.
#5 Write your friend three letters. Stamps, 10¢ each
#6 Your grandmother called you. She paid for the call.

Take a Gift
#1 Buy a game. $4.98
#2 Buy a pretty picture. $1.49
#3 Bake some cookies. Ingredients, 85¢
#4 Make a game. Materials, $ .38
#5 Give your picture. 68¢
#6 You can't decide. Try again next turn.

Buy a Ticket
#1 There is a long line at the ticket window. Try next turn.
#2 Bus ticket. $12.47
#3 Train Ticket. $14.13
#4 You bought a ticket $7.83 and lost it. Buy another.

#5 Airplane ticket. $20.38
#6 Your father is driving on business. Go with him.

To Entertain You on the Trip
#1 Buy a magazine. 49¢
#2 You don't buy anything.
#3 You shopped too long and missed your bus. Wait until next turn.
#4 Buy a game. $5.00
#5 Buy a newspaper. 10¢

Lunch Stop
#1 You brought a bag lunch.
#2 You bought a hamburger, soda, and ice cream. $1.16
#3 You ordered a plate lunch. $1.75
#4 You bought a hot dog and hot chocolate. 75¢
#5 You bought soup and a sandwich. $1.25
#6 You bought milk and a sandwich. 62¢

Souvenirs
#1 You spend 29¢.
#2 You spend $7.25.
#3 You buy nothing.
#4 You spend $1.50.
#5 You can't find anything you like.
#6 You buy one for 29¢ and one for 98¢.

Destination
#1 Take the city bus. 25¢
#2 Wait until your next turn for a taxi.
#3 Take a taxi. $2.40
#4 Someone is waiting to meet you.
#5 Telephone someone to come get you. 10¢
#6 The city bus just pulled away. Wait until next turn.

Circular Discs
There are 42 circular discs, divided into sets of 7. Each set of seven is of a different color, corresponding to the 7 sets of cards.
One die

NUMBER OF PLAYERS:

A cashier and 2 to 6 players

DIRECTIONS:

The cashier gives each player $28 as follows:

one ten-dollar bill	$10.00
two five-dollar bills	10.00
five one-dollar bills	5.00
two half-dollars	1.00
four quarters	1.00
six dimes	.60
six nickels	.30
ten pennies	.10
	$28.00

The seven groups of cards are laid out on a table.
The players roll a die to determine who goes first. The one with the highest number begins to play. He rolls

the die again. He picks up the white card whose number corresponds to the number on the die. He pays the cashier the amount of money specified on the card. He counts out the money, using the correct change, if possible. He must use the largest possible coins or bills (one dime instead of two nickels).

If the player does not have the exact amount, the cashier counts out the change in like manner. The cashier also gives the player a circular disc of the same color as the card he drew.

On each subsequent turn, the player will pick up a different colored card (in the same order as listed earlier) and the same colored disc from the cashier upon the completion of the transaction. However, if the card reads "Try next turn.", the player must draw the same colored card on his next turn.

Each player follows in turn, following the same rules.

If a player runs out of money, the cashier gives him another $28.00.

After everyone has reached his destination and received a pale green disc, the winner is the one with the most money.

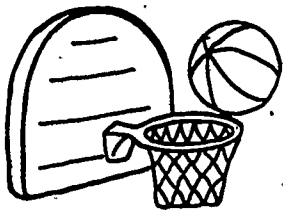
FOLLOW-UP:

Minimize the competition in this game, encouraging the children to give assistance if a cashier or player needs help in making change or counting money. There is a minimum of frustration in not being a winner—having money to count at the end softens the disappointment.

This game has great appeal to pupils, and will have more meaning if the pupils themselves have a large part in making it. Let them cut out and label the money. After they have played it once, let them suggest new ideas for the transactions. They might want to devise ways in which they might receive money from the cashier —interest on a savings account, weekly allowance, etc.

As the pupils show greater proficiency, let the transactions involve larger amounts of money.

If the teacher observes special difficulties, he may want to give some pupils additional activities to strengthen their skills in counting, addition, and subtraction.



GOAL #25:
The student will be able to identify or write the solution to a word problem which involves multiplying an amount in dollars and cents by a one-place factor.

PRE-ACTIVITY LEARNING: The pupil has learned to multiply a number with 2 decimal places by a one-place factor. He should already have mastered his multiplication tables through table 9.

ACTIVITY #1 ..... Story Problem

MATERIALS:

Pencil and paper

Story problem

NUMBER OF PARTICIPANTS:

One or more pupils

DIRECTIONS:

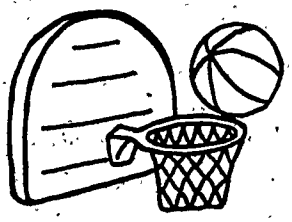
The teacher reads orally or gives the following written story problem to one or more pupils.

A man bought 5 bicycles for his children. Each bicycle cost $65.89. How much did the man spend?

FOLLOW-UP:

The teacher checks the pupil's work and answer. If there is a mistake, he gives the child additional activities on multiplication skills.

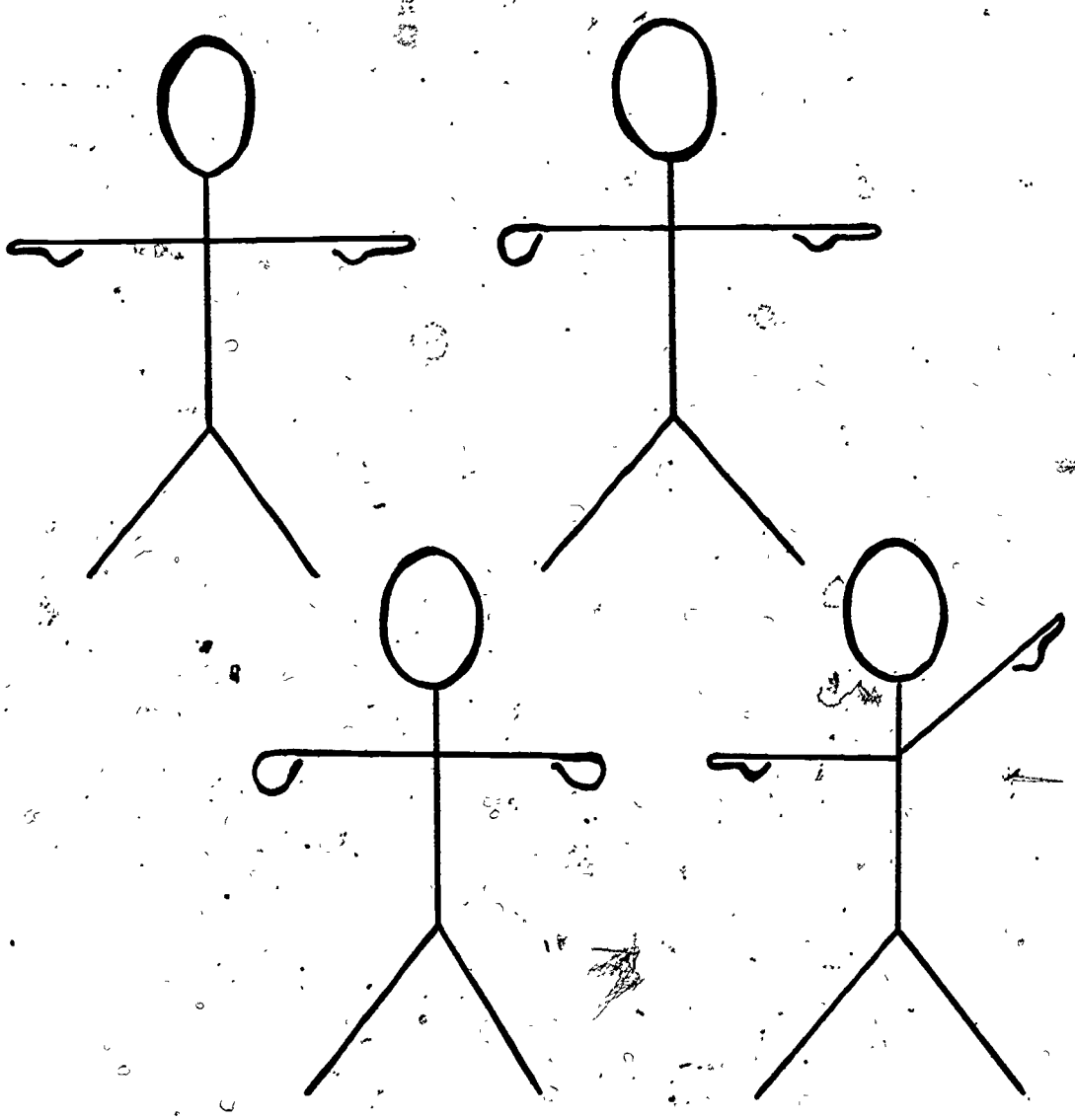
Even those children not making mistakes should be given some additional work where the knowledge of other multiplication facts is required.



GOAL #26:
The student will be able to identify a specific plane figure in a set of plane figures including a line, a line segment, a ray, and/or an angle.

PRE-ACTIVITY LEARNING: The teacher will have defined and illustrated a line, a line segment, a ray, and an angle.

ACTIVITY #1 ..... **Simon Says**



MATERIALS:

Just a teacher!

NUMBER OF PLAYERS:

The whole class or any subgroup

DIRECTIONS:

The teacher shows how, with his own arms, fists, and fingers, he can represent a line, a line segment, a ray, and an angle according to these instructions.

A line is represented by arms outstretched, fingers pointed.

A ray is one arm outstretched with fingers pointed and the other arm outstretched ending in a fist.

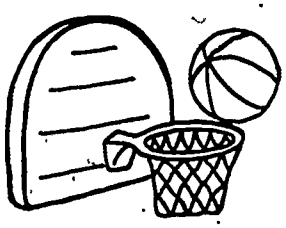
A line segment is represented by both arms outstretched, both ending in fists.

An angle is one arm outstretched and the other arm raised, both arms ending with fingers pointed.

The whole class stands up. It would be preferable to play this in the gym or out-of-doors where there is plenty of space. The teacher puts his arms and fingers in one of the positions as illustrated above and says, "Simon says 'Make a .....'." The pupils copy him if the words "Simon Says" preceded the command. If a pupil who copies him when he should not, he must sit down for the remainder of the game. The last pupil standing becomes the leader for the next game.

FOLLOW-UP:

Give the pupil an opportunity to name and draw plane figures from their own experience and environment. For more reinforcement, introduce activity No. 2 pertaining to goals 26, 27, 28.



GOAL #27:
The student will be able to identify a given pair of lines as parallel, perpendicular, or intersecting.

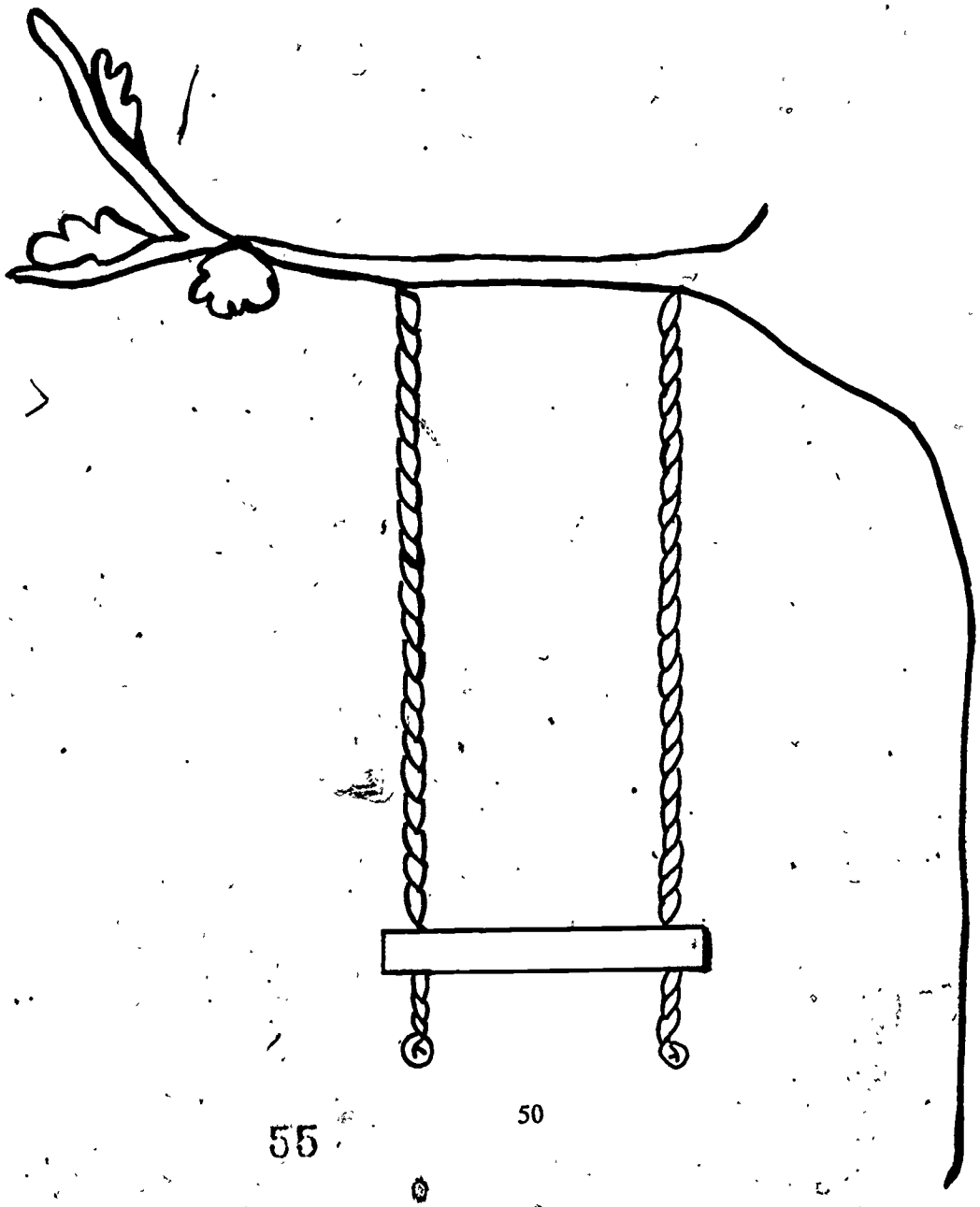
PRE-ACTIVITY LEARNING: The teacher will have defined and illustrated parallel, perpendicular, and intersecting lines.

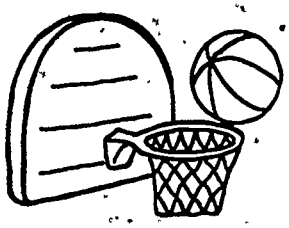
ACTIVITY #1 ..... Complete the story about the swing hanging from the apple tree

The ropes on this swing are ..... The seat is ..... to the ropes. Intersecting lines are formed by the ..... and the .....

FOLLOW-UP:

Give the pupils an opportunity to name and draw plane figures from their own experience and environment. For more reinforcement, introduce activity No. 2 pertaining to goals 26, 27, 28.





GOAL #28:
The student will be able to identify a specific plane figure in a set of plane figures including a triangle, a square, a rectangle, a non-rectangular parallelogram, and/or a circle.

PRE-ACTIVITY LEARNING: The pupil has learned by definition and illustration the plane figures mentioned above.

ACTIVITY #1 ..... **I'm Going to the Jungle**

MATERIALS:

Pictures of shapes as illustrated

NUMBER OF PLAYERS:

Five players

DIRECTIONS:

The first pupil holds up a picture of a circle, saying, "I am going to the Jungle. I am taking a compass shaped like a circle."

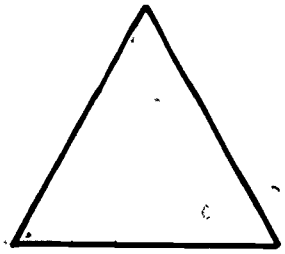
The second pupil repeats what the first person said. In addition, he holds up a triangle, saying, "I am taking a box for my insect specimens. It is shaped like a triangle."

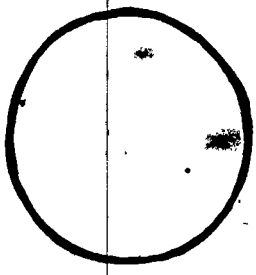
The other pupils follow, each one repeating what the others have said, then adding a new shape and a use for it.

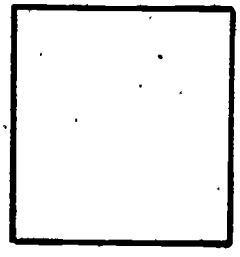
The pictures are given as an illustration; their order is of no significance.

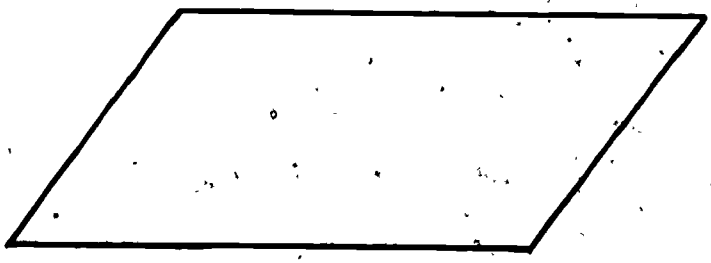
FOLLOW-UP:

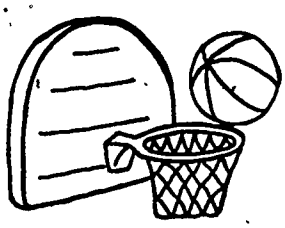
The pupils might make and label figures for mobiles. See activity #2.





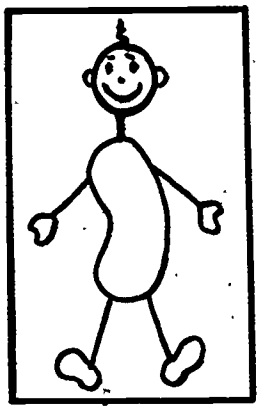


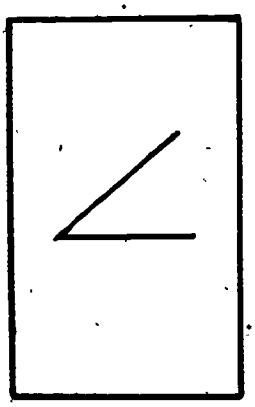


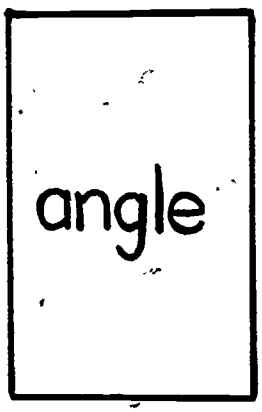


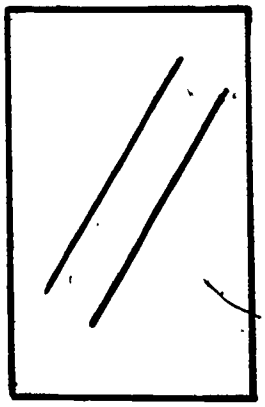
GOALS #26, 27, 28:
The student will be able to identify plane figures including a line, a line segment, a ray, an angle, a triangle, a square, a rectangle, a non-rectangular parallelogram, a circle and pairs of lines as parallel, perpendicular, or intersecting.

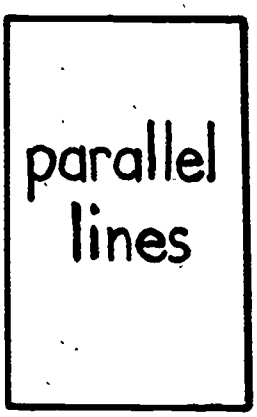
ACTIVITY #2 ..... **Math Nut**

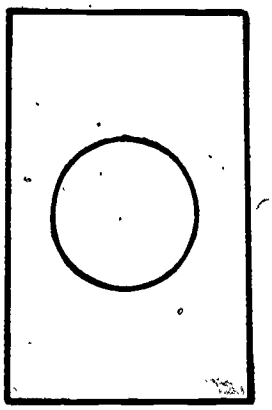


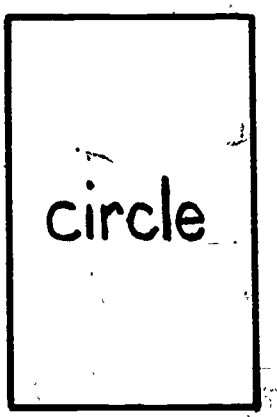












NUMBER OF PLAYERS:

Three to five players

MATERIALS:

Deck of cards made of pairs. A pair is made up of a card with an illustration such as a line segment and a card with the words "Line Segment."

DIRECTIONS:

The game follows the rules of "Old Maid." The player holding the "Math *nut*" card at the end of the game is the loser.

FOLLOW-UP:

Ask the pupils to look for pictures in magazines and to draw their own pictures to illustrate the concepts of goals Nos. 26-28.

GOAL #29:
The student will be able to measure a given line segment and identify or write the measure as a mixed number.

PRE-ACTIVITY LEARNING: The pupil has been introduced to the concept of the mixed number. He understands that a mixed number is the sum of a whole number and a proper fraction. He has learned to use a twelve inch rule, the inches of which are divided into halves and fourths.

ACTIVITY #1 ..... **Inch Worm**

MATERIALS:

A pair of dice

"Worm head"

Seven one-inch strips of colored paper

Scissors

Ruler

Pencil

Construction paper on which to paste the inch worm

NUMBER OF PLAYERS:

A group of six to eight pupils

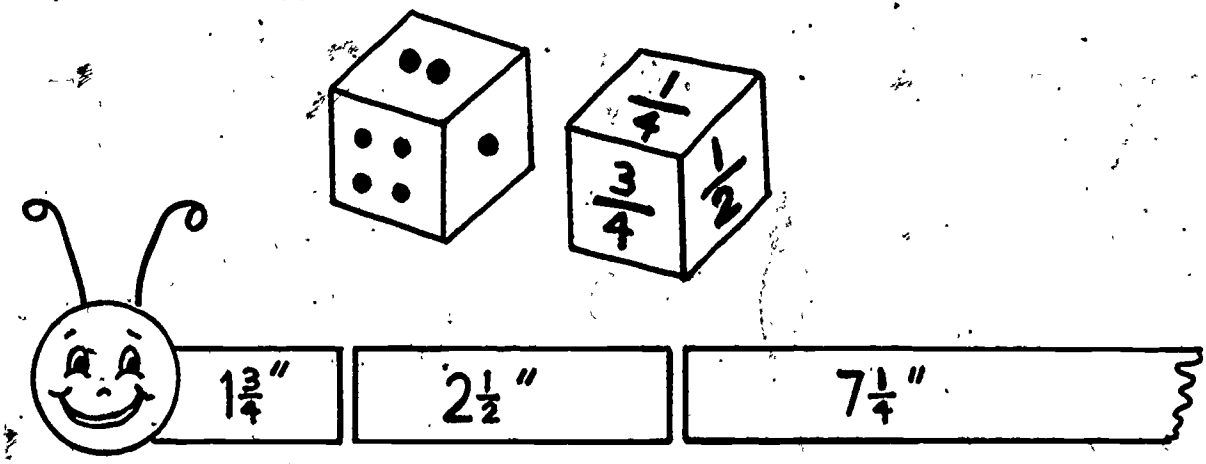
DIRECTIONS:

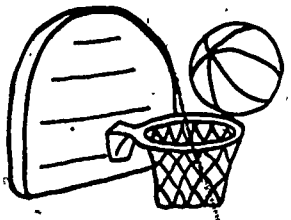
Cover one of the dice with proper fractions ½, ¼, ¾. Each fraction should appear twice. The pupils throw both dice and cut a strip of paper to the length corresponding to the sum of the lengths shown on the upper faces of the dice. The strips are attached to the worm head and then to each other. The first pupil to make a worm 20 inches long is the winner.

FOLLOW-UP:

The teacher should check with the children to help them read the graduations on the rulers.

An appropriate reinforcing exercise might be the construction of a miniature village in which all measurements are expressed in mixed numbers.





GOAL #30:
The student will be able to measure a given line segment and identify or write the length to the nearest inch.

PRE-ACTIVITY LEARNING: The pupil has learned to measure whole inches with a ruler. He has also learned the rounding-off conventions.

ACTIVITY #1 ..... **Big, Bigger, Biggest**

MATERIALS:

Activity cards

Tape measure

Ruler

Pencil and paper

NUMBER OF PLAYERS:

The number of players is limited by the number of rulers and tape measures available. This would probably restrict the size of the group to 6 or 8. The pupils should work in pairs.

DIRECTIONS:

Give one set of materials to each pair of pupils. On the activity cards should be written directions such as:

1) Measure the distance around your waist.
2) How tall are you?
3) Trace your shoe. How long is it?
   What is the greatest width across your toes?
4) Extend your arm. Have your partner measure the distance from your shoulder to the tip of your middle finger.
5) How high is the seat of your chair?

All measurements are to be made to the nearest inch. Directions may be read aloud if they are too difficult for the pupil to read independently.

The pupils draw the cards, make the measurements, and write the answers on a sheet of paper.

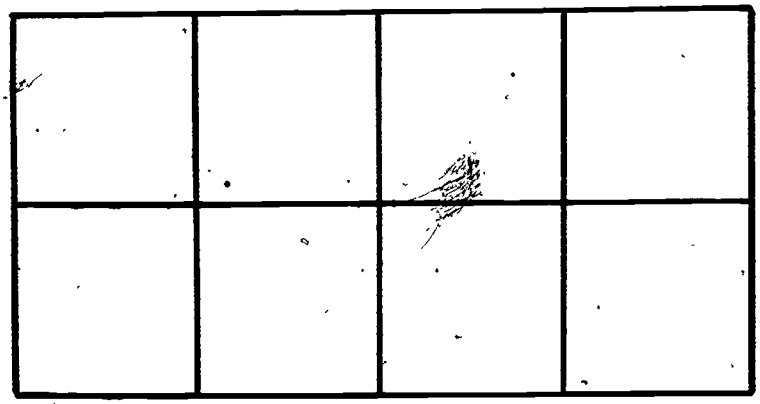
FOLLOW-UP:

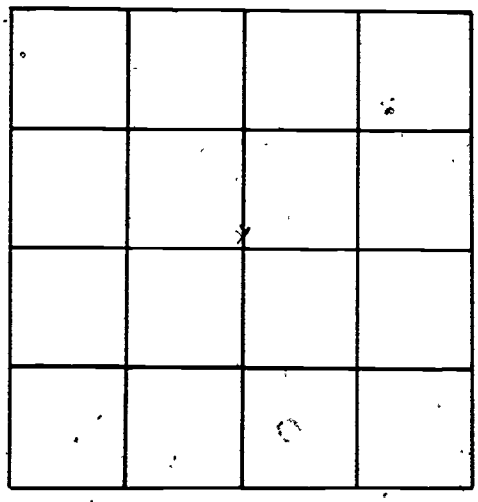
The teacher should check some of the measurements at random to see if the pupils understand the concepts of measuring and rounding-off. The teacher should also instruct the pupils to check their answers for reasonableness.

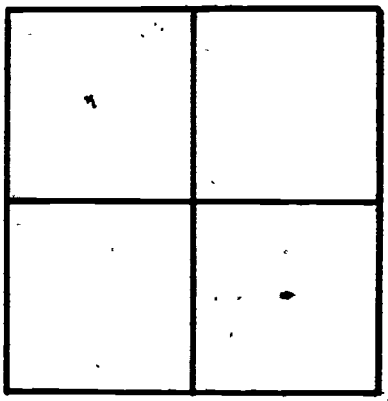
GOAL #31:
The student will be able to identify or write the area of a rectangular region by counting the number of square units in a given diagram.

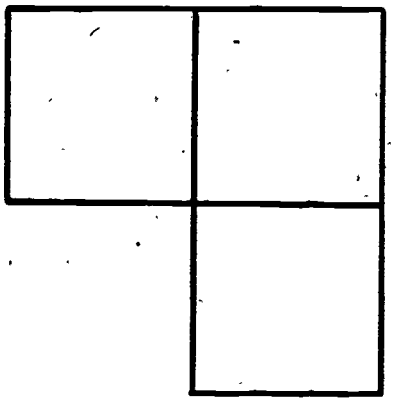
PRE-ACTIVITY LEARNING: The pupil will have learned the two dimensional concept of area, that area is measured and expressed in square units.

ACTIVITY #1 ..... How Many Squares?









MATERIALS:

Copies of the questions and diagrams, one set for each pupil

NUMBER OF PLAYERS:

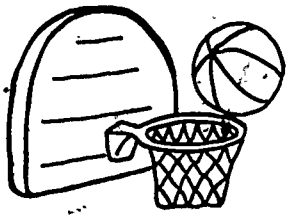
This is an individual activity.

STORY PROBLEMS:

1. How many squares can you count in this checkerboard? (See checkerboard illustration.)
2. My pool is bigger than yours. There are .... squares on the bottom of mine. Yours has only .... squares. My cousin's has only .... squares. (See 3 illustrated pools.)

FOLLOW-UP:

The activity should not present any real difficulty unless the pupil is careless. The pupils should be encouraged to make up some examples of their own and challenge their classmates.



GOAL #32:
The student will be able to identify or write the time to the nearest quarter hour, given the diagram of a clock showing time.

PRE-ACTIVITY LEARNING: The pupil has learned there are 60 minutes in an hour, 15 minutes in a quarter hour, 30 minutes in a half hour, and 45 minutes in three-quarters of an hour. The pupil has learned to distinguish between the functions of the hour hand and the minute hand. The pupil recognizes the four quarter-hour positions and knows the names associated with them.

ACTIVITY #1 ..... **Time Old Maid**

MATERIALS:

The deck consists of Old Maid type cards where the pairs are clock faces and their time names.

NUMBER OF PLAYERS:

The game is suitable for 3 or 4 players.

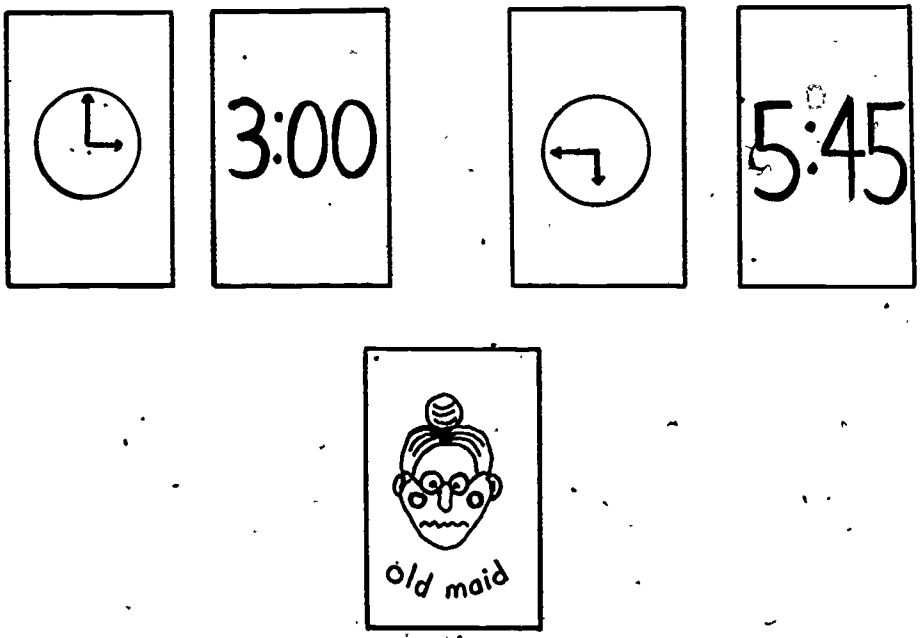
DIRECTIONS:

This game is played by the rules of "Old Maid." Time names and clock faces are matched and discarded until one person is left with the old maid. He is the loser.

FOLLOW-UP:

Procure or make some clock faces with hands that can be moved. Very simple ones can be made from cardboard and brass brads. Let the pupils work in pairs, one setting the clock and the other naming the time.

Clock faces that do not show any movement of the hour hand between consecutive hours are unreal. The teacher should explain that the hand does move so that at six-thirty, for example, the hour hand points to a position half-way between the six and the seven.



GOAL #33:
The student will be able to order any subset of the set: ounce, pint, quart, gallon in terms of volume.

PRE-ACTIVITY LEARNING: The teacher has named and shown containers for an ounce, pint, quart, and gallon, has explained the need for them, and has demonstrated that the larger units are made up of exact multiples of the smaller ones.

ACTIVITY #1 ..... **Fish**

MATERIALS:

Deck consisting of
12 cards labeled "ounce"
12 labeled "pint"
12 labeled "quart" and
12 labeled "gallon"

NUMBER OF PLAYERS:

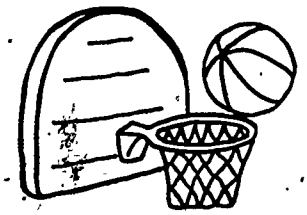
Three or four players

DIRECTIONS:

The cards are shuffled, and each player is dealt four cards. The remaining cards are put face down on a table. Each player picks up his four cards. As an example, the first player looks at his cards and sees that one of them is labeled "ounce." He says to one of the others, "I have ounces. I want to pour them into a pint. Give me a pint, please." If the person addressed has a "pint" card, he gives it to the asker. The asker lays down the pair, "ounce," to the left of "pint" and he asks continually until he is refused. The refusal is phrased "Fish." The asker takes one card from the face-down pile. Play passes to the next player. The one getting the most pairs wins. They must always be placed so that the smaller unit card is on the left. One always asks for the next larger unit. That is, if one has ounces, he can only ask for pints, never quarts or gallons.

FOLLOW-UP:

The teacher should watch to see if the pupils are having trouble ordering the subset. It might be helpful to display the labeled containers for the first game or two. Another aid might be a mnemonic device such as "Oats, peas quickly grow."



GOAL #34:
The student will be able to identify or write the indicated temperature given a diagram of a thermometer.

PRE-ACTIVITY LEARNING. The teacher would have explained the idea of degrees as a unit of measure as well as the concept of negative readings.

ACTIVITY #1 ..... **Hor or Cold**

NUMBER OF PARTICIPANTS:

This is a group activity.

MATERIALS:

Laminated thermometers for individual use

Grease pencils

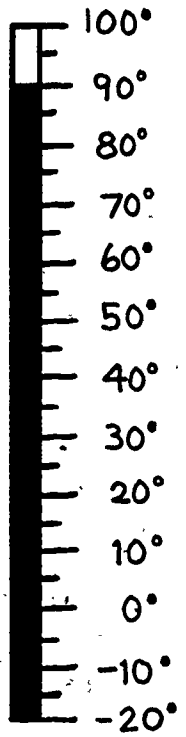
Classroom thermometer with an elastic band

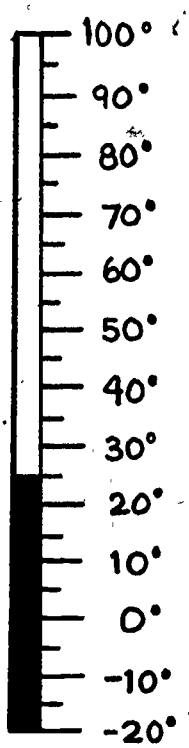
DESCRIPTION:

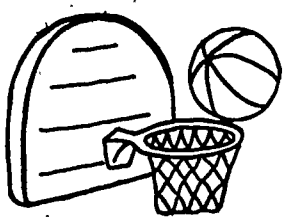
The teacher sets her large thermometer on various temperatures and has individual pupils read the temperatures. When pupils appear to have mastered this task, they mark on their individual laminated therometers a given temperature, using a grease pencil. The teacher checks the pupils' thermometers. The pupils also make up their own temperatures and exchange them with classmates.

FOLLOW-UP:

A posttest is given where the pupils are asked to read thermometers and make thermometers which correspond to given readings.







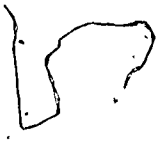
GOAL #35:
The student will be able to identify or write a specific fact, according to the information given on a simple bar graph.

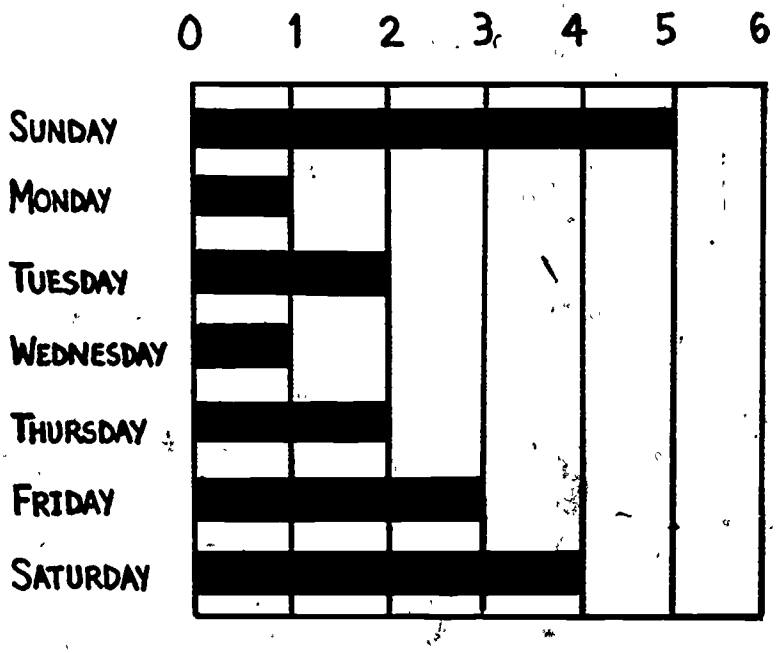
PRE-ACTIVITY LEARNING: The pupils have seen bar graphs in their texts and have practiced reading them.

ACTIVITY #1 ..... **What about Tom?**

MATERIALS:

Bar graph large enough for class to read or copy onto individual sheets





THE NUMBER OF HOURS TOM SPENT READING AT HOME.

NUMBER OF PARTICIPANTS:

Any number. Perhaps the whole class.

DIRECTIONS:

Ask the children to answer the following questions:

1) How many hours did Tom read on:
   Sunday =
   Saturday =
   Total Hours

2) How many hours did Tom read on:
   Monday =
   Tuesday =
   Wednesday =
   Thursday =
   Friday =
   Total Hours

3) How many hours did Tom read in one week?

4) Which day did he read the most?

5. Which days did he read the same amount of time?

6. Make a chart and show how many hours you spend reading.

FOLLOW-UP:

The children can collect data and make graphs on a variety of subjects such as temperatures, their own weights and heights, etc. Let one group think of questions based on their graph to ask another group to answer.