DOCUMENT RESUME

ED 050 976 SE 011 321

TITLE	Mathematics for Basic Education, Grade 7, A Tentative Guide.
INSTITUTION	Baltimore County Public Schools, Towson, Md.
PUB DATE	Sep 67
NOTE	393p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$13.16
DESCRIPTORS	Behavioral Objectives, Course Content, *Curriculum Guides, Elementary School Mathematics, *Grade 7, Instruction, Low Ability Students, *Mathematics Education, *Slow Learners, Worksheets

ABSTRACT

This curriculum guide is specifically designed for the slow learning students in grade 7. It is one of a series of course guides for grades 6-11. The intent of the curricular designers was to outline mathematical experiences which would be appropriate for the characteristics of these students. The areas of mathematical content included are: 1) numbers, operations and algorithms, 2) geometry, 3) measurement, 4) graphing, 5) probability and statistics, 6) algebra, 7) logic. Each content area contains: 1) master charts for grades 6-11, 2) grade level chart for grade 7, 3) behavioral objectives for the area, 4) teacher commentary sheets, 5) student worksheets. A collection of recreational activities is included for student motivation. (RS)

MATHEMATICS FOR BASIC EDUCATION

GRADE 7

Baltimore County Public Schools

BALTIMORE COUNTY PUBLIC SCHOOLS

Mathematics for Basic Education

Grade 7

A Tentative Guide

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September, 1967

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FOREWORD

The last ten years have reflected a growing awareness and concern by mathematics educators for slow learners. Recent conferences sponsored by the National Council of Teachers of Mathematics and the School Mathematics Study Group have focused their attention upon the various aspects of the slow learner--economic, sociological, psychological, and pedagogical. Researchers are now able to present some of the preliminary findings of their work to curriculum specialists. Curriculum materials are being developed, but these are limited and have not yet been produced commercially.

The Office of Mathematics has been deeply involved in this pioneering stage. Staff members have participated in the recent NCTM conference, attended national conventions which have presented important addresses on the slow learner, and invited consultants for assistance and guidance. The summer workshops in 1963 and 1964 produced bulletins which presented guidelines and recommendations for the mathematics education of the slow learner. The summer workshop in 1966 produced a resource manual of activities--developmental, recreational, and computational--as a first stage in creating a mathematics program for the slow learner. The efforts of this 1967 summer workshop have been directed toward providing structure and continuity of the desired behavioral outcomes as they relate to mathematical concepts and skills

This publication is specifically designed for the slow learning students in Grade 7. It is one of a series of tentative course guides in Mathematics for Basic Education, Grades 6-11. It will presume teacher evaluation in terms of student reaction and behavioral responses. The teacher is urged to study carefully the philosophy of behavioral objectives as stated in action words and its implications for instruction and assessment. These ideas are stated in the following sections of the Introduction.

The Board of Education and Superintendent of Schools wish to express their appreciation to the curriculum committee and to all mathematics teachers of Baltimore County whose effort made possible the development of this curriculum publication. The staff wishes to acknowledge the valuable contributions of Dr. Henry H. Walbesser, University of Maryland, and Dr. Max A. Sobel, Montclair State College.

Special commendation is due Mrs. Betty V. Hagedorn, Mrs. Barbara S. Parks, and Miss Martha Ann Lynch for their careful and painstaking effort in the production of this bulletin.

William S. Sartorius
Superintendent of Schools

Towson, Maryland
September, 1967

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INTRODUCTION

A. PHILOSOPHY

The rapid trends toward greater automation, use of computers, and the increased technological skills demanded of workers have dramatically reduced the market for unskilled and semi-skilled laborers. Twenty percent of our population consists of persons, who, according to their academic talents, are termed "slow learners." It becomes apparent that young people of limited ability, who are potential unskilled and semi-skilled workers, must be prepared for a useful place in our society. Unless these youths are taught salable skills, they must be supported by tax money. This situation could lead to a society composed of one segment which is overworked to contribute tax dollars and services, and another segment which is unemployed and consumes the wealth, yet produces nothing.

The magnitude and urgency of this problem demand that schools develop appropriate educational opportunities for slow learning students throughout their school experiences. The schools are thus faced with the problem of training students for jobs and services which may be outmoded by the time they enter the business world. Equally disturbing is the fact that no one can foretell the many new jobs and products which will be created for which no training has been provided. It is generally conceded that the service occupations hold the greatest promise of employment for the slow learner. Functional competence in mathematics is essential for all persons entering these service occupations. Industry is retaining many semi-skilled and unskilled workers who have been displaced by automation through extensive retraining. Reports indicate that greater success is obtained in retraining workers who have more mathematics background than those who do not. Furthermore, training in mathematics provides youth with broader choices of vocational employment. It is imperative that the student be given a sound foundation in mathematics if he is to function effectively as a producer and consumer, and a citizen in his community.

It is axiomatic that the slow learner should be educated in his own right and to the maximum of his ability. Any adaptation of an academically oriented program must surely fail. A program of mathematics for the slow learner should be based upon the latest developments and research in learning theory, an appropriate selection and reorganization of mathematical topics, and the inclusion of new materials as well as new techniques for presenting mathematical concepts and developing skills. Proper pacing of these concepts and skills must underlie the entire structure. All the human resources of the educational system - the mathematics teacher, the principal, the mathematics supervisor, resource teachers, the guidance counselor, and other specialists - must be brought to bear on this problem.

Probably the most important factor in the success of a mathematics program for the slow learner is the teacher. Such a teacher should be prepared psychologically to teach students of limited ability. This implies an acceptance of the student for what he is, and an awareness of the operational level of the student. Furthermore, the teacher should have such characteristics as emotional maturity, a broad background of mathematics and a curiosity for more, a liking for young people, patience, and above all, a sense of humor. Such a teacher can do much to enhance the usually poor self-image of the slow learner, and convince the student that he is indeed a person worthy of dignity and respect in this society.

B. IDENTIFICATION OF THE SLOW LEARNER

The most obvious characteristic of the slow learner is his inability to keep pace with those students who are average in their rate of academic growth. However, other psychological, social, cultural, and physical factors may be considered in identifying these students. The following criteria, which are divided into two categories, may be used to form a basis for the selection of the students who may be classified as slow learners. The two criteria - measurable and traits - should receive equal consideration when the student is being identified.

Measurable Criteria

1. I.Q. Range 75 - 90 resulting from at least two group tests or an individual test.
2. Percentiles on group tests of mental ability and achievement ranging from 0 - 19 (approximately two or more years below grade level in reading comprehension and arithmetic.)
3. Teacher grades - consistently below average, as indicated by "ability" C's and D's as well as E's.

Traits Criteria

1. Limited academic interest
2. Difficulties in planning and in carrying out work without supervision
3. Limited creativity and intellectual curiosity
4. Indications of short attention span
5. Severe limitations in the ability to communicate orally or in writing.

C. BEHAVIORAL OBJECTIVES

An integral part of any collection of instructional materials is a statement of the objectives. This bulletin is no exception. The objectives stated here are stated in behavioral terms. That is, each objective is stated in terms of the desired student behaviors.

To clarify, consider the following example of a behavioral objective which is taken from the Grade 7 geometry section of this bulletin.

> The student should be able to construct a drawing of a quadrilateral using a straightedge.

The characteristics of this objective are that it tells who is to perform, how he is to perform, and what constitutes an acceptable performance.

To assess the acquisition of the above stated behavior it is only necessary to give a student paper, pencil, and straightedge and instruct him to make a drawing of a quadrilateral. In response, the student can either make such a drawing or he cannot. In any event, it is possible to decide whether or not the stated objective has been realized. Any well stated behavioral objective should point clearly to the type of performance task necessary to assess its attainment.

The clarity of a behavioral objective such as the one stated above is in clear contrast to the vagueness of comparable objectives which state that the student should "understand the concept of quadrilateral" or that the teacher should "develop the concept of quadrilateral." These and other objectives such as "developing appreciations and attitudes" do not lend themselves well to evaluation. Indeed, the assessment of these qualities have always posed difficulties for researchers.

Behavioral scientists such as Jean Piaget and Robert Gagne have asserted that true learning involves a change on the part of the learner so that he no longer reacts as he did before. His whole being views similar situations in a new light. If our instructional program is to effect such changes in slow learning students, then the objectives such be so constructed that they specifically state the desired behavioral responses which are observable and hence can be assessed.

D. ACTION WORDS USED IN STATING BEHAVIORAL OBJECTIVES

The action words which are used to construct behavorial objectives are:

1. IDENTIFY

The student selects by pointing to, touching, picking up, or circling the correct object or class name. This class of performances also includes identifying object properties such as rough, smooth, straight, curved.

e.g. The student should be able to identify the prime numbers from a given set containing prime and composite numbers.

2. DISTINGUISH

The student identifies objects or events which are potentially confusable. This is a more difficult identification.

e.g. The student should be able to distinguish between ordered pairs such as (a, b) and (b, a).

3. CONSTRUCT

The student generates a construction using instruments, a freehand drawing, or by building a model. (Ed. note: This [illegible] a [illegible] a [illegible] Sound, etc.)

e.g. The student should be able to construct a copy of an angle given a straight edge and a compass.

The student constructs an answer or example. The teacher is concerned only with the student's ability to construct the answer or example, not the method or procedure he uses in arriving at the solution.

e. g. The student should be able to construct the product of a fraction and a whole number.

4. NAME

The student supplies the correct name for a class of objects or events orally or in written form.

e. g. The student should be able to name the associative property of addition in the set of whole numbers.

The student names the correct solution to a problem. This is different from construct in that an immediate response is expected. In this sense Name is used in relation to the basic ~~arithmetic~~ facts which students should commit to memory.

e. g. The student should be able to name the addition facts through 9.

5. ORDER

The student arranges or classifies two or more objects or events in proper order in accordance with a stated category. This word is used when the student arranges something from largest to smallest, most to least, or fastest to slowest.

e.g. The student should be able to order a set of whole numbers from largest to smallest.

6. DESCRIBE

The student states all the necessary categories or properties relevant to the description of a designated situation. The student's description must be stated so clearly that any other individual could use the description to do a task, identify an object, or perform an operation. The description is mostly verbal; however a model, hand motions, or a written example could be used to aid in the description.
The teacher must be willing to accept more than one response. For example the student might describe something in terms of his surroundings, by using example, or by stating a definition. The description may include color, size, shape, etc.

e.g. The student should be able to describe sample spaces as ordered arrangements, listing all possible outcomes.

7. STATE A PRINCIPLE OR RULE

The student makes a verbal statement which conveys a rule or principle. This is more limiting than describing in that only one basic response is acceptable. Students may use their own words in stating the rule. For example, when asked the question, "How do you find the area of a square?" a ~~A~~ student may respond: "To find the area o' a square, measure the length of a side and multiply this number by itself," or "$A = S^2$." Both are acceptable answers. Any formula, theorem, or definition is a statement of a rule.

> e.g. The student should be able to state the principle that the circumference of a circle equals pi times diameter, ($C = \pi D$).

8. APPLY THE RULE

The student uses a rule or principle to derive an answer to a question. The question is stated in such a way that the student must employ a rational process to arrive at the solution. the ~~Students~~ student might not be able to state the rule; however, he may still be able to apply it.

> e.g. The student should be able to apply the principle of casting

nines to check addition problems involving whole numbers.

9. DEMONSTRATE

The student shows a procedure or test for the application of a rule or principle. The teacher wants the student to show how he arrived at an answer, not just the answer alone. This usually involves some action, other than verbal, on the part of the student.

e.g. The student should be able to demonstrate a procedure for finding the least common multiple of a given pair of numbers.

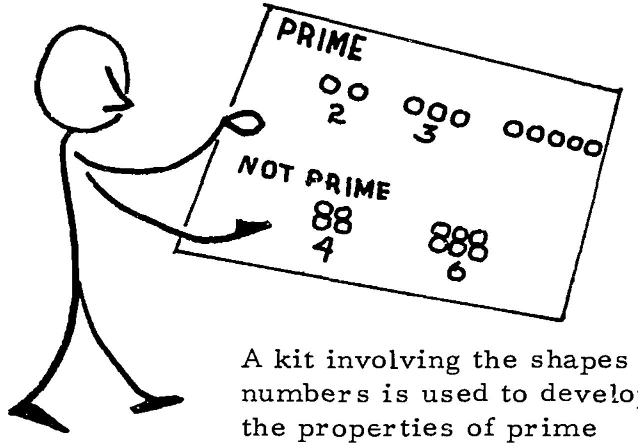
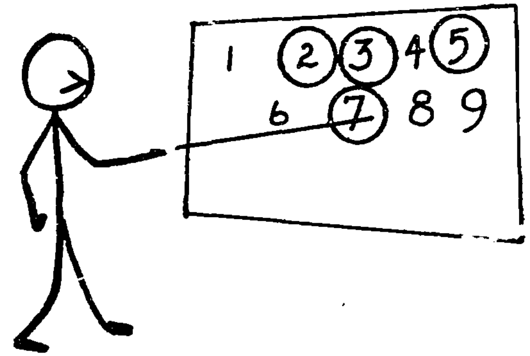
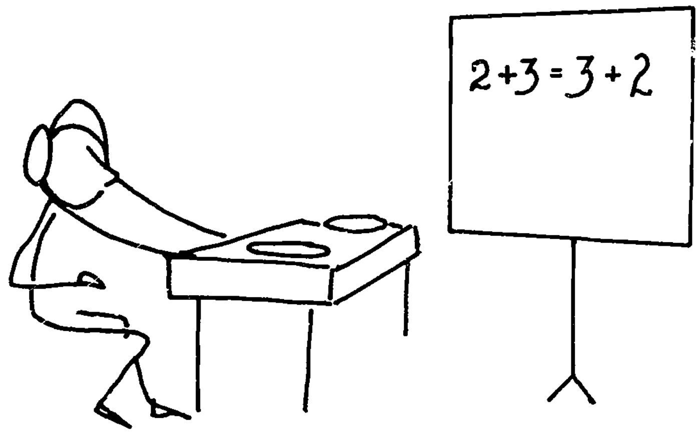
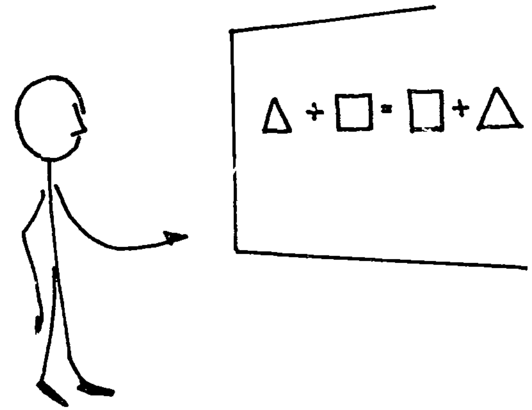
10. INTERPRET

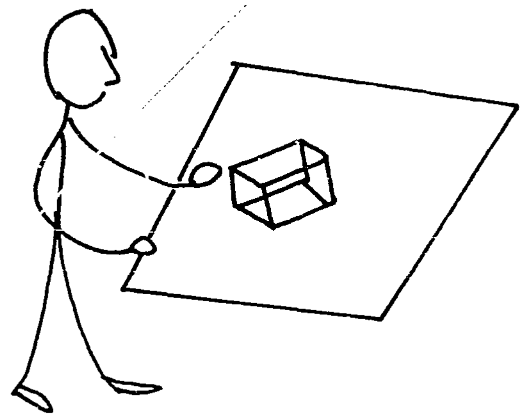
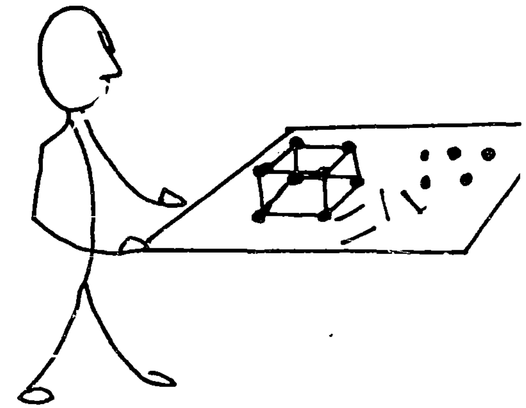
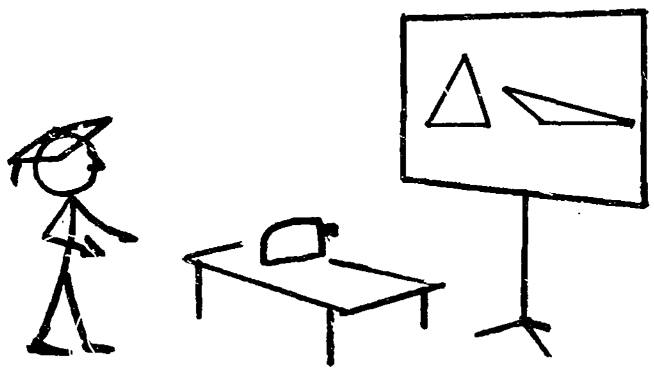
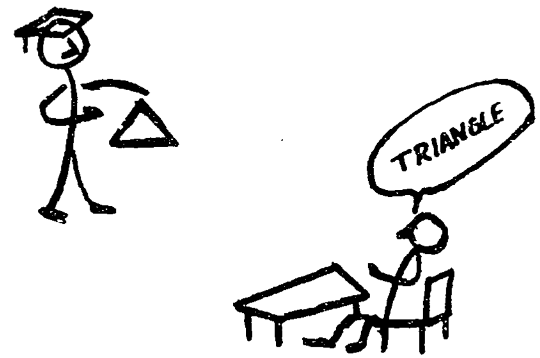
The student uses several rules or principles to draw a conclusion, or identifies objects and/or events in terms of their consequences. This constitutes a high level of learning, since the student must see various relationships in order to arrive at the desired conclusion.

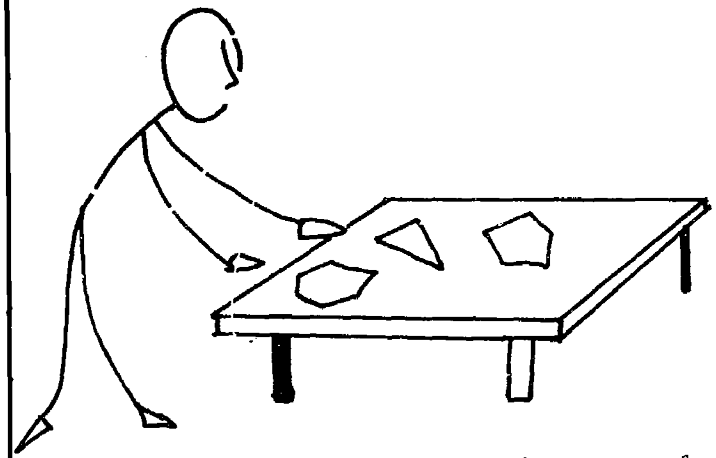
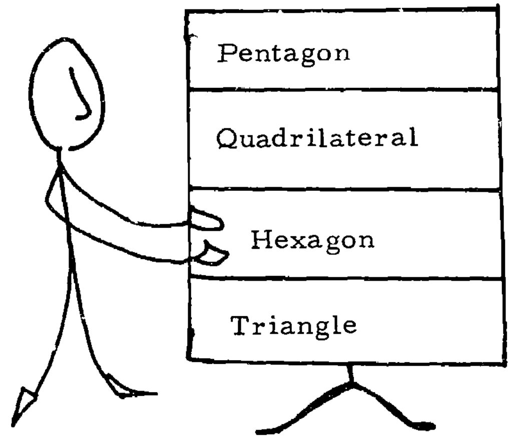
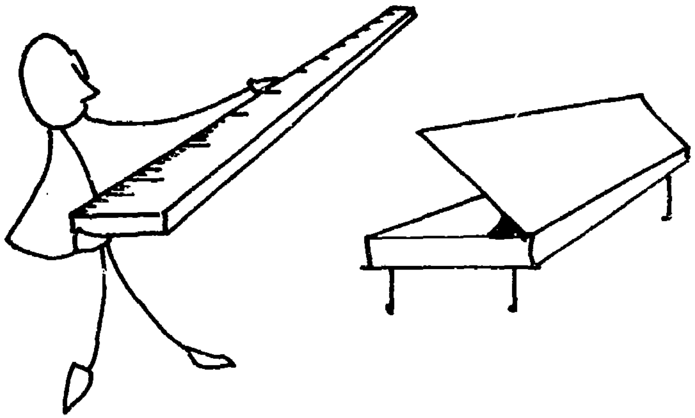
e.g. The student should be able to interpret the principles of angle measure by measuring and then classifying angles as right, acute, obtuse, straight, complementary, and supplementary.

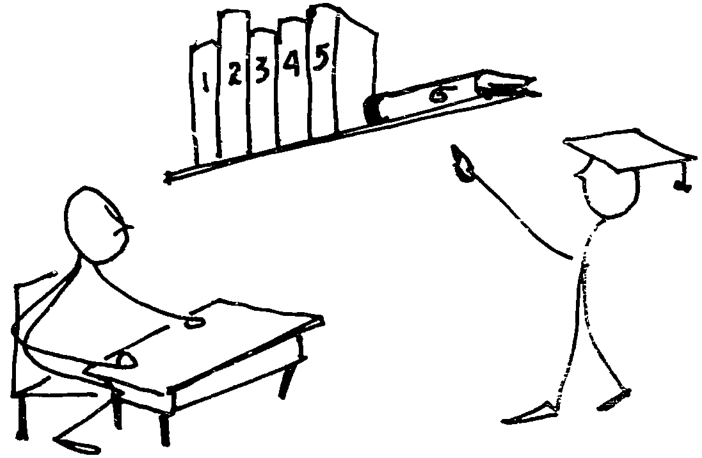
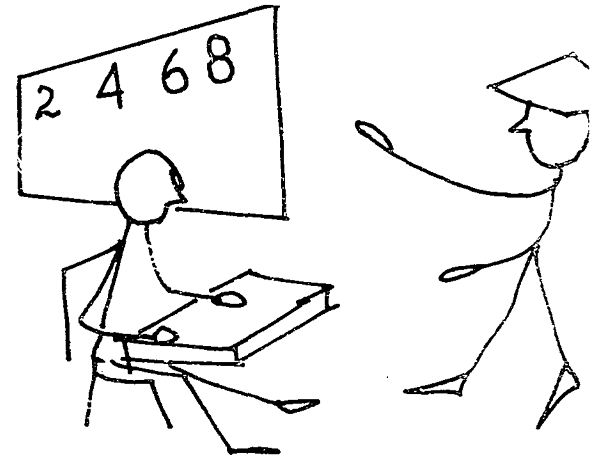
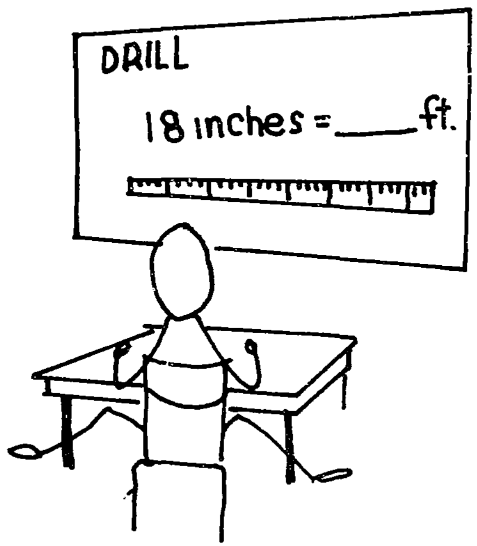
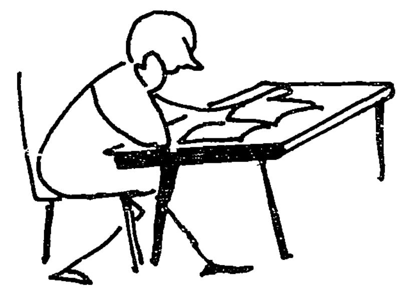
E. OBJECTIVES - INSTRUCTION - ASSESSMENT

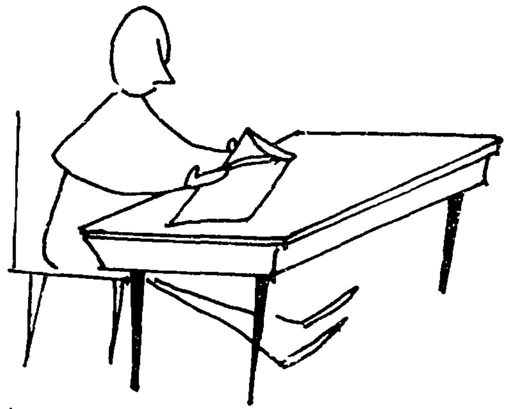
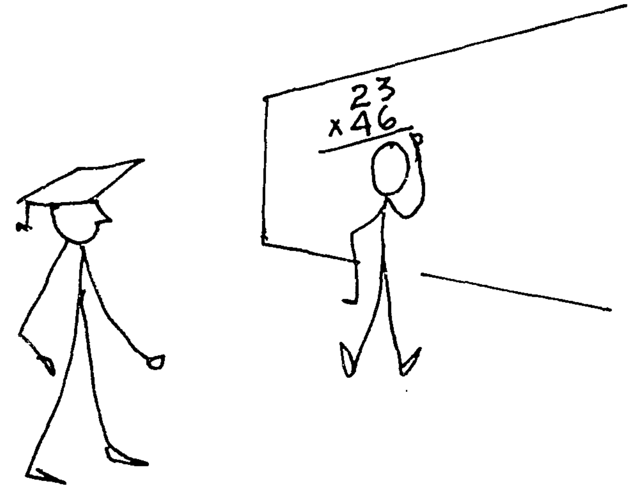
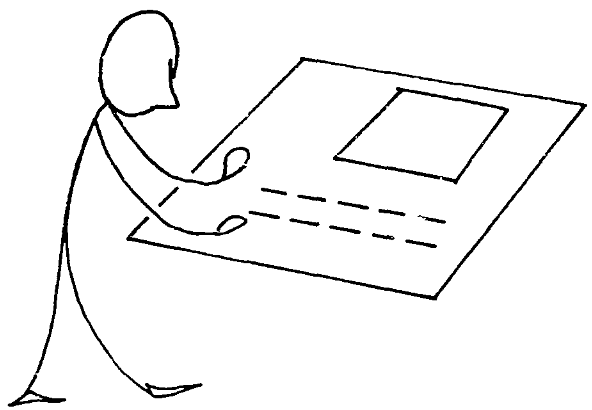
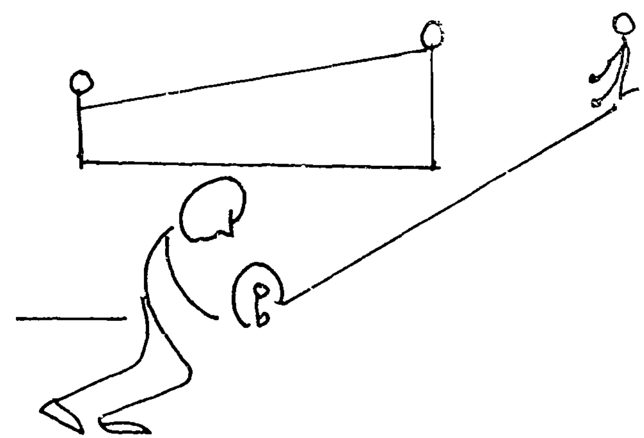
In each of the instructional activities included in this grade the focal point of most comments is the student. First the objectives of the activities are stated in terms of the desired behavioral outcomes on the part of the student. Secondly, the lessons are devoted primarily to student activities. Finally, the suggested assessment procedures indicate ways in which the student shows whether or not he has acquired the desired behavior. In effect, there should be a one-to-one correspondence between the set of objectives, the set of learning activities, and the set of assessment items. The following examples should clarify the relationship.

OBJECTIVE	INSTRUCTION	ASSESSMENT
1. The student should be able to <u>identify</u> a prime number less than 25.	 A kit involving the shapes of numbers is used to develop the properties of prime numbers.	 Students are to circle the numbers which are prime.
2. The student should be able to <u>distinguish</u> among the commutative, associative and distributive properties of addition.	 A tape and filmstrip are used to present the properties.	 Students are given examples on the board and instructed to identify each property.

OBJECTIVE	INSTRUCTION	ASSESSMENT
3. The student should be able to construct a model of a cube given appropriate materials.	 Given straws and string make a model of a cube.	 Use toothpicks and gumdrops to build a model in the shape of a cube
4. The student should be able to <u>name</u> a triangle.	 Filmstrip is used initially to present the name triangle.	 A model is used to assess the student's ability to name a triangle.

OBJECTIVE	INSTRUCTION	ASSESSMENT
5. The student should be able to order polygons in terms of increasing number of sides.	 Use models to order polygons in terms of increasing number of sides.	 Use the flannel board to order polyg in terms of increasing number of sid
6. The student should be able to describe a foot.	 Using kits students are introduced to the foot as a unit of measure.	 Student may describe a foot by a hand motion.

OBJECTIVE	INSTRUCTION	ASSESSMENT
7. The student should be able to state the principle that events which are certain to happen have a probability of 1.	 Six math books on a shelf are used to illustrate what is the probability of picking a math book if blindfolded.	 Studer' states "The probability of selecting an even number is certain t happen, so it has a probability cf 1."
8. The student should be able to apply the principle that 12 inches equals 1 foot to convert a measure expressed in one unit to the other unit.	 A drill on converting inches to feet is used to introduce the topic.	 A written test is used for assessment purposes.

OBJECTIVE	INSTRUCTION	ASSESSMENT
9. The student should be able to demon-strate a procedure for constructing the product of two whole numbers.	 Student uses book to work problems at his seat.	 Students show work at the board.
10. The student should be able to interpret the rules for finding the areas of rectangles and computing in order to solve related problems.	 Students are asked to find the number of tiles necessary to cover the sheet of paper, and then compute to check their results.	 Students measure the dimensions of the tennis court, then compute to find its area.

F. THE BANDED APPROACH

Teachers who participated in the experimental program last year developed a method of teaching which seems to be effective with the slow learner. The key to the success of this method was that a variety of mathematical topics were incorporated into each lesson. Naturally, small group instruction, individual lab work, extensive use of audio-visual aids, games and the like provided the variety of activities within the lesson which is necessary to change the pace when working with this ability student. Thus, the student was exposed to a program of instruction which provided a variety of activities as well as a variety of mathematical content within a given period. This method of teaching will be referred to as the "banded approach."

To elaborate further the "banded approach" is a flexible way of organizing instructional activities in the class period. Normally the lesson is divided into three bands, although sometimes it may be divided into one, two, or even four bands depending on the nature of the activity. All bands are not necessarily concerned with the same mathematical topic. For example, a unit on Geometry might be taught along with related activities on Fundamental Operations. Thus, the unit on Geometry is split into smaller parcels and presented over a longer period of time rather than being presented as a two week concentrated unit. Since basic students typically have short attention spans, the material must be presented within a smaller time interval. Thus, the major portion of the lesson might be presented during a 25 minute segment since this seems to be about the maximum length of time these students can concentrate on any one activity.

Description of Bands

Band I is usually a short activity of about 5 - 10 minutes duration. For example, students may review their addition facts using the Math Builder, have an oral number puzzle, or complete a number pattern. The variety of activities which might be used is numerous.

Band II usually contains the major topic for the day. It is about 25 minutes in length. For this activity, specific behavioral objectives are stated. Students are exposed to instructional activities which are designed to enable them to acquire the desired behaviors. Assessment procedures might also be employed here to determine whether students have acquired some of the behaviors specified in the objectives. Remaining objectives may be assessed in other bands of subsequent lessons.

Band III is usually a short activity of about 5 - 10 minutes. This band can be handled two ways. First, all the students might begin work at the same time on a class activity. Secondly, as each student completes his work in Band II he begins some planned individual or small group activity. For example, after a student has completed his work from Band II, he may go to a specified place in the room and pick up an interesting puzzle or game, work on one of the SRA kits, or listen to a tape at the listening post. This approach keeps students actively involved in learning activities rather than just waiting for the class to finish an assignment. Thus, a more efficient use of the student's time is made.

The teacher should realize that the above descriptions indicate a general outline of what constitutes a banded approach. Flexibility is the key. Teachers should vary the number of bands as well as the length of time devoted to each depending upon what is being presented.

To illustrate how this approach could be implemented with your students, a sample two week unit is included in section H at the end of the Introduction. This unit contains:

1. A block plan indicating the topics to be presented each day.
2. Detailed lesson plans indicating the materials to be used, the behavioral objectives, suggested methods for presentation, student work sheets, and assessment items.
3. A series of inventory tests designed to indicate areas of difficulty.

This two week unit should be taught near the beginning of the school year. It is hoped that this unit will provide a model from which the teacher can create other units utilizing the same approach.

G. HOW TO USE

This guide provides a structured program of instruction for the slow learner in mathematics grades 6 - 11. Suggestions for implementing the program are included. The teacher is urged to read this section carefully. Familiarity with the materials included and suggestions for their use should be of great assistance in determining the best program of instruction for basic students.

The guide is divided into the following major areas of mathematical competency: Fundamental Operations, Geometry, Measurement, Graphing, Algebra, Probability and Statistics, and Logic. Recreation is the last section of the book.

Each of the areas of mathematical competency contains the following items:

MASTER CHARTS

These charts give an overview of the mathematical content and the behaviors students are to acquire in grades 6 - 11. The teacher can use these charts to get a picture of the total mathematics program for the slow learning student. Furthermore, the teacher can see which behaviors the students should have acquired prior to entering this grade, which behaviors will be developed during this grade, as well as those to be developed later.

GRADE LEVEL CHART

These charts are identical to the master charts except they contain only the information for a specific grade. They can be used to get an overview of those behaviors which should be acquired by the student during the school year.

LIST OF BEHAVIORAL OBJECTIVES

A list of behavioral objectives for this grade should enable the teacher to interpret the details omitted in the chart. The teacher can use these objectives when planning lessons, since they state precisely what is expected of the student. The teacher should realize that these objectives should not necessarily ' aught in the order they are presented, rather objectives from several eas might be used in order to present a logical development of the topic. However, by the end of the year the students should be able to exhibit all the behaviors mentioned.

Also included in this section are references to the student activities which have been developed. These activities have been specifically designed to bring about the desired behavioral changes indicated in the objectives. This should assist the teacher in identifying the type of activity which might be used when developing a particular topic.

STUDENT ACTIVITIES

This section contains a series of suggested activities.

For each activity a Teacher Commentary printed on yellow paper is included. This commentary indicates the title of the activity, the unit, the behavioral objectives, necessary materials, a procedure for implementation and suggested assessment items. Student work sheets are printed on white paper and immediately follow the Teacher Commentary. The teacher can reproduce these work sheets by taking the master copy out of the guide and making a thermal spirit master. The spirit master can then be used to run off copies for the students. Be sure to place the original copy back in the guide so it can be used again at a later date.

If color is desired it may be added by using colored masters before duplication.

The Student Activities section also includes references to:

1. Kits. These kits are effective devices for use in small groups or with individual students. Students perform various experiments and as a result of this experimentation, are lead to generalizations. The teacher is supplied with all the necessary instructions for constructing the kit as well as the accompanying student work sheets. It is suggested that the teacher use student help in the construction of the kits.

2. Tapes. Some tapes and their related student work sheets are included. These tapes cover a variety of topics on each grade level. It is suggested that these tapes be used with small groups of students using listening posts, rather than as a class activity.
3. Programed Instruction. Several programed booklets are included in the guide. These can be used with individual students or small groups for remedial purposes or when the teacher feels additional development might be necessary. The programed booklets can be reproduced using the same procedures outlined for the student work sheets. Again, it is suggested that student help be employed in assembling the programed booklets.
4. Films. Several films are included in the Teacher Commentary. These films can be obtained from the Baltimore County Central Film Library. They can be used with the banded approach since the average running time is between 10 - 15 minutes.

RECREATIONAL ACTIVITIES

The Recreation section of the guide is significantly different from the sections dealing with mathematical competencies. The activities described in this section are designed to develop a positive attitude towards mathematics. There are no behavioral objectives specified in this section. Games and puzzles play an important role in the teaching of mathematics. These activities are to be used throughout the year for motivational purposes. When using the banded approach, the recreational activities are used extensively since they help provide the variety which is necessary to the success of this method of teaching.

In the period of time allocated to produce this guide it was impossible to create activities in each of the areas. Therefore, provisions were made to supplement this guide as other activities are developed. Teachers are requested to send activities which they have found to be successful to The Office of Mathematics so that they may be added to this guide.

H. A SAMPLE UNIT USING THE BANDED APPROACH

SAMPLE UNIT OF BANDED LESSONS - Grade 7

OUTLINE OF TOPICS

LESSON	BAND I	BAND II	BAND III
1	Drill-geometric figures	Parallel lines	4-digit numbers
2	Drill-patterns	Symbols for segment and ray, assessment of parallel lines	Puzzle-optical illusions
3	Math Builder	Copying segments -straightedge	Tape-addition
4	Puzzle-multiplication and addition	Copying segments -straightedge and compass	Math Builder
5	Math Builder	Assessment-copying segments	Cross Number Puzzle-place value
6	Drill-patterns	Midpoint-paper folding	Construction of ruler
7	Math Builder	Midpoint-compass and ruler	Puzzle-multiplication and addition
8	Puzzle-division	Assessment-midpoints	Cross Number Puzzle-multiplication
9	Math Builder	Symbols for angle, vertex	Puzzle-renaming numbers
10	Tape-verbal problems	Copying angles-compass and straightedge	Tic-Tac-Toe game
11	Diagnostic Test-addition of whole numbers	Copying angles	Continuation of Tic-Tac-Toe game
12	Puzzle-calendars	Assessment-copying angles	Puzzle-hidden words

LESSON 1

I. Unit: Geometry

II. Objectives: The student should be able to:

A. Construct a drawing of a plane

B. Name and identify the figure and symbol for parallel lines

C. Construct a drawing of parallel lines using a straightedge or freehand sketch

D. Describe parallel lines as lines which have the same direction and never intersect

III. Materials:

A. Band I - None

B. Band II

1. Railroad board

2. Straightedge, pencil

3. Work sheet entitled, "Parallel Lines"

C. Band III - None

IV. Procedure:

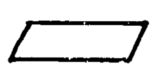
A. Band I - Written Drill Involving Geometric Figures

1. Have this drill written on the board for students to do as they come into the room.

2. Drill: Name each of the following geometric figures

a. . P

b. $\longleftrightarrow$

c. 

d. ———

e. $\longrightarrow$

3. Discuss the answers with the students.

4. The student should put the number of answers correct out of 5 in the margin of his paper.

5. Have students put their drill paper in their notebook until the next day, at which time they will use it in a similar exercise as they come into the room.

B. Band II - Lines in a Plane

1. Tell students that you are thinking of a geometric figure that is represented by:

   a. the chalkboard

   b. the desktop

   c. a sheet of paper

   What figure am I thinking of? (Plane)

2. Ask students to name some other physical representations of planes.

3. Ask students to name the characteristic common to each of these representations. All are flat.

4. Hold up the railroad board as a representation. Consider the plane rather than the representations. Ask students to name some other characteristics of a plane.

   a. A plane is made up of a set of points.

   b. A plane has no thickness.

   c. A plane extends on and on; it has no boundaries.

5. Hold up a sheet of railroad board. Have students sketch a picture of a plane using the railroad board as a model.

6. Have a student draw his picture of a plane on the chalkboard. The teacher should make any necessary changes. Have students draw several more pictures of planes at their desks.

7. Explain that today they are going to learn about a new type of geometric figure involving lines in a plane. This figure is called parallel lines. Write this on the chalkboard and have the class pronounce it.

8. Using the chalkboard, illustrate an example of parallel lines. Also use some examples of parallel lines in the classroom such as lines in a tile floor, woodwork, window frames, and lines on notebook paper.

9. Students shall give many physical examples of parallel lines such as:

   a. streets

   b. rows of desks in a classroom

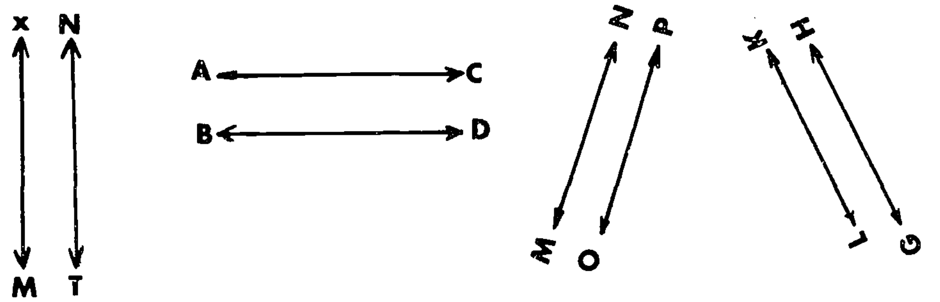
   c. halls

   d. opposite edges of a door

   e. sides of a ruler

   f. train tracks

10. Use other examples on the board to show various positions of parallel lines.



Have students draw some parallel lines with their rulers. Also ask them to draw some lines which are not parallel.

11. Show the symbol for parallel lines. Students will name lines parallel to each other from the above drawings.

    Examples: $\overleftrightarrow{AC} \parallel \overleftrightarrow{BD}$; $\overleftrightarrow{MN} \parallel \overleftrightarrow{OP}$

12. Ask students for descriptions of parallel lines. Accept a description indicating that such lines have the same direction and never intersect.

13. Re-emphasize the following points:

    a. If two lines have the same direction and do not intersect, they are parallel.

    b. The symbol for parallel lines is $\parallel$.

14. Suggested Assessment Procedure

    a. Distribute work sheets for students to complete.

    b. In oral drills, ask students to describe parallel lines.

C. Band III - Writing Whole Numbers - 4 Digit

1. Distribute sheets of paper to students.

2. Have students write 4 digit whole numbers as the teacher dictates them.

   Numbers:

   a. 4, 975

   b. 5, 003

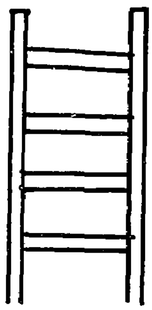
   c. 7, 050

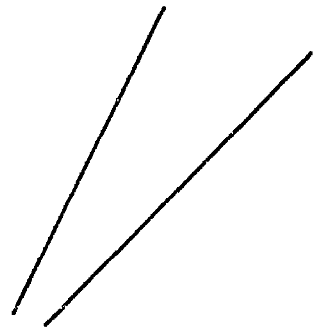
   d. 9, 101

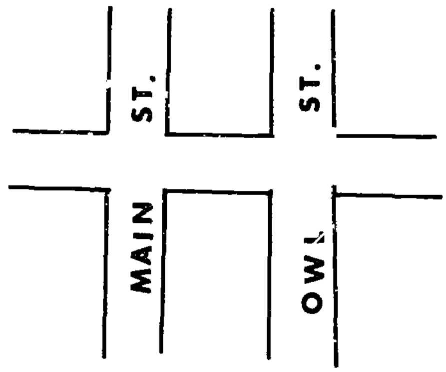
3. Have each answer written on the board by students.

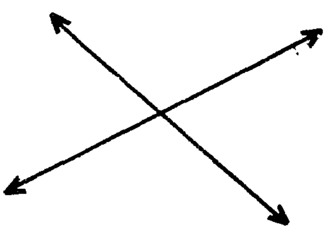
PARALLEL LINES

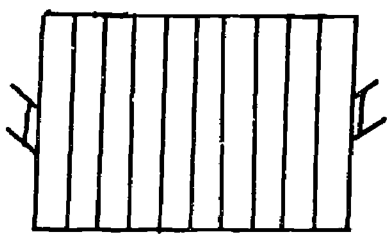
Directions: Some of the figures below contain a pair of parallel lines. Write the word "parallel" on the line below each figure containing parallel lines.

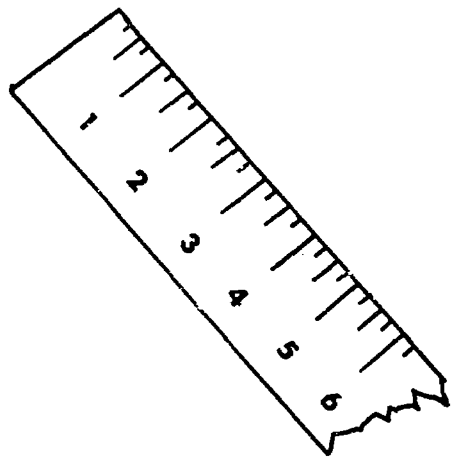


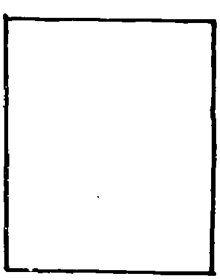


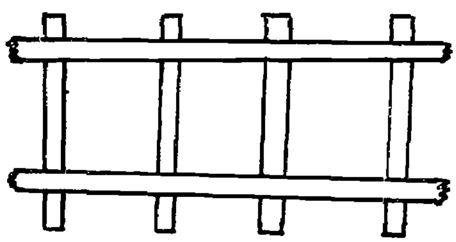












LESSON 2

I. Unit: Geometry

II. Objectives: The student should be able to:

Name and identify the symbols for segment and ray

III. Materials:

A. Band I - None

B. Band II - Work sheet entitled, "Fancy Figures"

C. Band III

1. Work sheet entitled, "The Eyes Have It"

2. Ruler and pencil

IV. Procedure:

A. Band I - Written Drill Involving Patterns

1. Have this drill written on the board for students to do as they come into the room.

2. Drill: What Comes Next? Place the missing numbers in the blanks provided.

a. 1, 3, 5, __, __, __, 13, __, __

b. 3, __, 9, __, __, 18, __, __, 27

c. 15, 12, 9, __, __, __

d. 15, 18, __, __, 27, __, __, __

3. Discuss patterns and answers with students.

4. Have students place their scores in the margins of their papers (same as yesterday).

5. Have students put their drill papers into their notebooks.

B. Band II - Lines, Segments, Rays

1. Tell students that you are thinking of a geometric figure that is represented by a straight, level road. What figure am I thinking of? (line)

2. Ask students to name other physical representations of lines.

3. Write the word line on the chalkboard and then have a student draw a representation of a line.
4. Help students name the line using the symbol for line, e.g. $\overleftrightarrow{AB}$.
5. Using the same procedure outlined in steps 1-4 above, develop the symbol for segment, e.g. $\overline{AB}$.
6. In a similar manner, develop the symbol for ray, e.g. $\overrightarrow{AB}$
7. EMPHASIZE that A is the end point of this ray.
8. When you feel that students can name these three geometric figures, have them complete the work sheet entitled, "Fancy Figures."

C. Band III - The Eyes Have It

1. As each student completes his work sheet from Band II, he should begin the work sheet entitled, "The Eyes Have It." The work sheet should be placed somewhere in the room where each student may get his copy when he is ready and begin working.
2. Be sure to give students help in following directions, if necessary.
3. Solutions to "The Eyes Have It"

1. True	4. True	7. True
2. True	5. True	8. True
3. False	6. False	9. True

FANCY FIGURES

Draw a line from the figure or symbol in Column I to the word it matches in Column II.

Column I	Column II
1. $\|\|$	Plane
2. $\longleftrightarrow$	Point
3. . L	Symbol for parallel lines
4. ————	Line
5. $\longrightarrow$	Ray
	Segment

Using a straightedge, make a drawing of each of the following:

6. Parallel lines

8. A plane

7. Non-Parallel lines

Use symbols to name each of the following geometric figures.

9. R ———— S

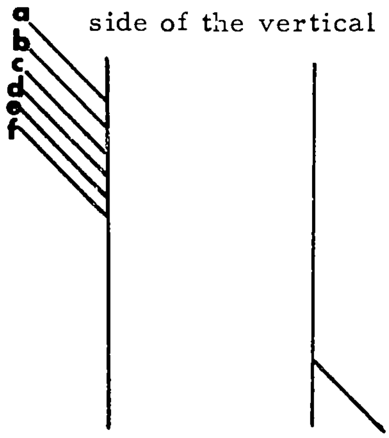
10. $\longleftarrow$ N ———— M $\longrightarrow$

11. $\longleftarrow$ X ———— Y

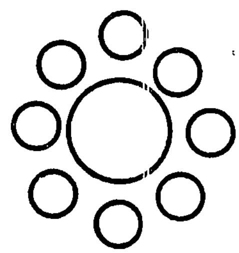
THE EYES HAVE IT

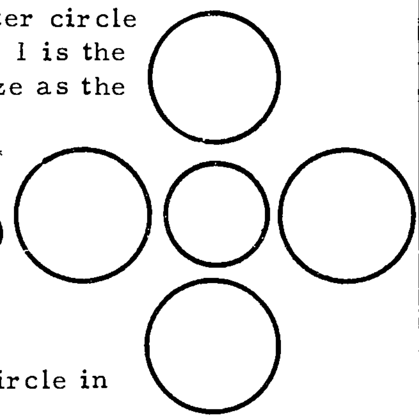
Study each problem carefully. Underline the correct answer that tells if the statement is true or false.

1. True - False
   Line c is the line on the right side of the vertical lines.

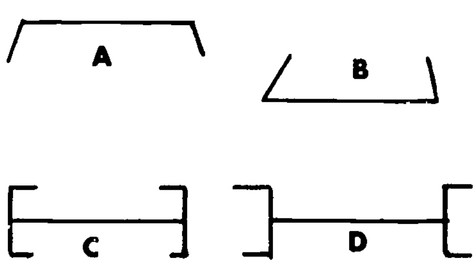


2. True-False
   The center circle in figure 1 is the same size as the center circle in figure 2.

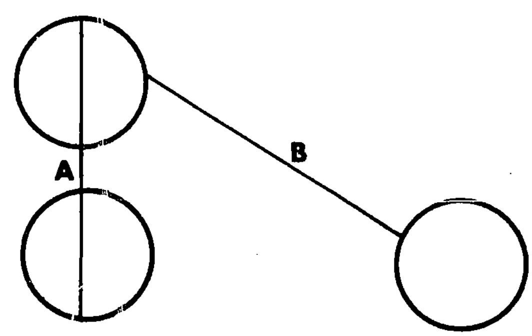




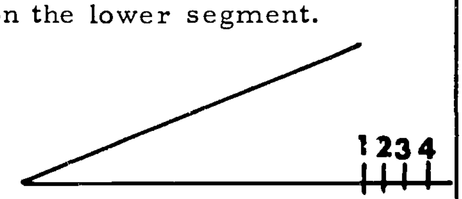
3. True - False
   Line B is the longest of the four straight lines.



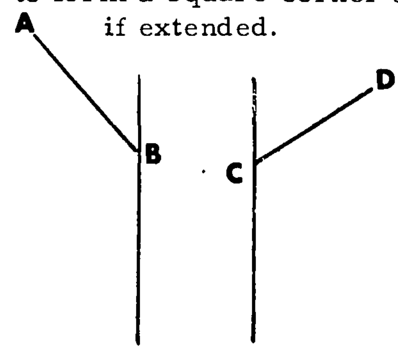
4. True - False
   Line A and line B are the same length.



5. True - False
   The upper segment will extend as far as the number 2 on the lower segment.

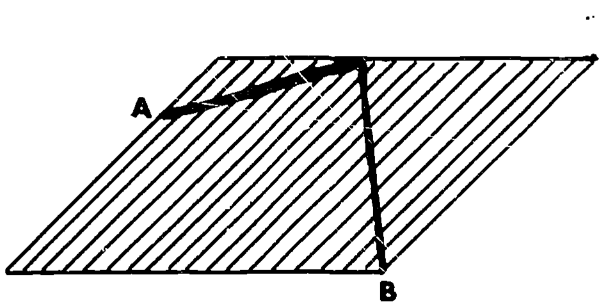


6. True - False
   Line AB will intersect line CD to form a square corner at point C, if extended.

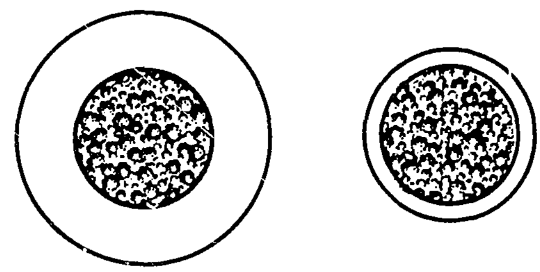


Ten minutes are almost up and you still have 3 more to do!!

7. True - False
Lines A and Pencil B are the same length.

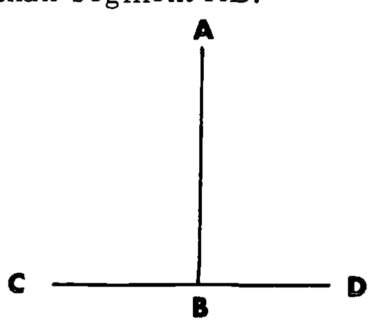


8. True - False
The shaded regions in both



figures have the same amount of space inside.

9. True - False
Segment CD is greater in length than segment AB.



Scores:

9 correct - Excellent

8 correct - Good

6-7 correct - Fair

5 or less correct - Your eyes deceive you badly.

SCORE:

Name:

LESSON 3

I. Unit: Geometry

II. Objectives: The student should be able to:

Demonstrate how to construct a copy of a given segment by matching end points of the segment with points on a straightedge

III. Materials:

A. Band I

1. Math Builder
2. Filmstrip ML-AR (Number Recognition) 4

B. Band II

1. 1 piece of railroad board 1" by 9" (for each student) to be used as a straightedge
2. Work sheet entitled, "Copy Cat"

C. Band III

1. Tape: Practice in Addition (22 minutes)
2. Tape recorder
3. Work sheet and pencil

IV. Procedure:

A. Band I - Number Recognition Using the Math Builder

1. Have the students get out their drill papers from the previous day and letter from a through j.
2. Do Exercise A of filmstrip ML-AR-4 using the full line frame and masking C3 and C4. The students should orally identify if the two numbers are the same or different. Set the variable speed control at approximately 20-25. The speed will have to be adjusted to the individual class.
3. Do Exercise B using the full line frame and masking C3 and C4. The students respond by writing S if the two numbers are the same or D if the numbers are different on their drill paper. Set the variable speed control at approximately 15.

4. Check the answers by re-running this exercise and having a student read his answers.

5. Have the students letter from a through j on their paper.

6. Do Exercise B using the full line frame and masking C1 and C2. The same procedure should be followed as in items 3 and 4 above.

7. The speed may be increased as the students become more proficient.

B. Band II - Copying Line Segments Using a Straightedge

1. Have students name some of the geometric figures they have studied thus far this year.

2. One figure they will probably name is the line segment. Ask what they have learned about a segment this year, e. g. physical representations, how to draw it, how to name it.

3. Have each student draw a segment on his paper. Then hold a few of the drawings up or tape them to the chalk-board. Ask the students if the drawings are similar. Then ask students what is different about these drawings. (different lengths)

4. Ask students if they think they might all be able to draw segments with the same length. (Yes or No)

5. Tell students there are two ways that they will learn to do this:

   a. By matching end points of the segment with points on a straightedge

   b. Using a straightedge and a compass

   Students will use the first method of copying a segment.

6. Give each student a straightedge made of railroad board and a work sheet entitled, "Copy Cat."

7. Ask them to see if they can copy the first segment on a sheet of notebook paper.

8. Check each student's work. When everyone has completed the first problem have a student go to the board and describe how he copied the segment.

9. Have students continue until they have copied all ten segments.

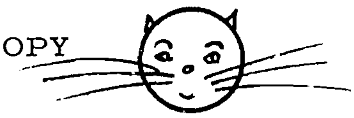
10. Have students demonstrate how they have copied segments with their straightedge. (Make students aware that by placing the straightedge on their papers, they have used it as a measuring device.)

C. Band III

1. Distribute work sheets to accompany tape "Practice in Addition." These are to be used for recording answers.

2. Have students follow directions as given on the tape.

COPY



Use your straightedge to copy the following segments. You may place your copy below each given segment.

1. ______________________________

2. ____

3. _______________

4. ____

5. _________________________

6. ____

7. ___________________________________

8. ____

9. _____

LESSON 4

I. Unit: Geometry

II. Objectives: The student should be able to:

Demonstrate how to construct a copy of a given segment by a compass and a straightedge

III. Materials:

A. Band I - None

B. Band II

1. Work sheet, "Copy Cat II"
2. Straightedge for students to use at board
3. Straightedge for each student to use at seats
4. Compass for each student

C. Band III

1. Math Builder
2. Filmstrip ML-AR (Lines) 2

IV. Procedure:

A. Band I - Puzzle Involving Multiplication and Addition

	Example:
1. Have each student write a 1-digit number on his paper.	1. 1
2. Multiply this number by 5.	2. 1 x 5 = 5
3. Now add 6 to the product.	3. 5 + 6 = 11
4. Multiply this sum by 4.	4. 11 x 4 = 44
5. Add 9 to this product.	5. 44 + 9 = 53
6. Multiply this sum by 5. This is the answer.	6. 53 x 5 = 265

7. Have a student, one at a time, tell his answer. The teacher may give the original number.
8. Solution:
   a. Mentally cross out the ones and tens digit.
   b. Subtract one from the number that is left.
   c. From the example problem: 265 = 2~~65~~, 2 - 1 = 1, which is the original number

B. Band II - Copying Line Segments Using a Compass and a Straightedge

1. Review:

   a. Have a segment drawn on the board.

   b. Have one student go to the chalkboard and demonstrate how to copy a segment using just the straightedge.

   c. Have another student describe the method used to copy the segment.

2. Tell students they will learn another method for copying segments. For this method, a pencil, straightedge, and a compass are needed.

3. Make sure each student has the necessary tools.

4. Give each student the work sheet entitled, "Copy Cat II."

5. Ask them if they can think of a way of copying the first segment using the second method.

6. Make sure students do not use straightedge as a measuring device.

7. You may find the overhead projector to be a helpful aid in presenting this.

8. When you feel students understand what they are to do, let them continue until they have copied all 10 segments.

9. Have students describe how they have copied segments with a straightedge and compass. (Make students aware that they are not just using their straightedge to draw segments. They are also using the compass.)

C. Band III - Counting Line Segments - Filmstrip ML-AR, Number 2, Lines

1. Have the tudents get out their drill papers and letter from a through j.

2. Using the full line frame, mask out either half and have the students write down how many lines they see. Use the slowest possible speed.

3. Check the answers.

4. Using the full line frame have the students decide which side has the greater number of segments by orally responding "left," "right," or "same." Use the slowest possible speed.

COPY  II

Use your straightedge and compass to copy the following segments. You may place your copy below each given segment.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

LESSON 5

I. Unit: Geometry

II. Materials:

A. Band I

1. Math Builder

2. Filmstrip ML-AR (Series) 3

B. Band II

1. Straightedge

2. Compass

3. Ruler

4. Work sheet entitled, "Copying Line Segments"

C. Band III

1. Work sheet entitled, "Cross Number Puzzle" - review of whole numbers

2. Pencils

III. Procedure:

A. Band I - Number Patterns Using the Math Builder, ML-AR, 3

1. Have instructions for students to number their drill papers as follows:

Exercise A	Exercise B
a.	a.
↓	↓
j.	j.

2. Check Exercise A before going to Exercise B.

3. Speed control could be set up for students using Exercise B.

B. Band II - Assessment for Copying Segments

1. Distribute the quiz entitled, "Copying Line Segments." Have students complete the quiz and then carefully check over their work.

2. After students complete number 1, have them get a cross number puzzle from the rear of the room (mentioned in Band III). This will eliminate students waiting for other students to complete the assignment.

C. Band III - Cross Number Puzzle

1. Have work sheets located in the rear of room. As students complete their test, tell them they are to get a copy of this interesting puzzle.

2. Solution:

1			2	4			1
6	8		3	0		5	6
4	4		8	0		1	9
		2			7		
1		5	2	8	0		1
2	1		4	2		2	5
9	9		9	0		8	5
	0					6	

COPYING LINE SEGMENTS

Copy the following line segments using only a straightedge.

1. 

2. 

3. 

Copy the following line segments using a straightedge and compass.

4. 

5. 

6. 

Measure each of the following segments to the nearest $\frac{1}{2}$ inch using a ruler.

7. 

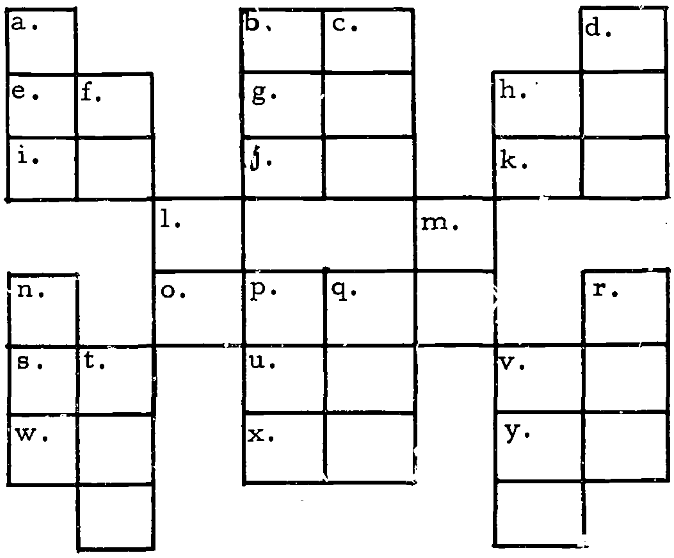
8. 

Use a ruler to draw two segments for the measurements listed below:

9. $2\frac{1}{2}''$

10. $5\frac{3}{4}''$

CROSS NUMBER PUZZLE



Across

b. 4 sixes

e. 2 less than 7 tens

g. Thirty

h. Fifty-six

i. 6 less than 5 tens

j. Eighty

k. 1 ten and 9

o. Number of feet in a mile

s. Twenty-one

u. 2 more than 4 tens

v. $\frac{1}{4}$ of one dollar

w. 9 more than 9 tens

x. Ninety

y. 15 less than 100

Down

a. One hundred sixty-four

b. Two hundred thirty-eight

c. Four hundreds

d. One less than 170

f. 6 less than 9 tens

h. 5 tens plus one

i. 5 less than thirty

m. Seven tens

n. One hundred twenty-nine

p. 2 hundreds, 4 tens, 9 ones

q. 8 hundred plus 2 tens

r. 5 less than 160

t. One hundred and 9 tens

v. 14 less than three hundred

LESSON 6

I. Unit: Geometry

II. Objectives: The student should be able to:

A. Name the midpoint of a segment

B. Identify the midpoint of a segment

C. Demonstrate a method for determining the midpoint of a segment by paper folding

III. Materials:

A. Band I - None

B. Band II

1. Strips of paper 1" wide-random lengths for each student

2. Marking pencil for locating midpoints

C. Band III

1. Strips of paper 8" long and 1" wide for each student

2. Colored pencils

3. Student work sheet entitled, "Tommy Tin Man"

4. Strips of railroad board 8" long and 1" wide for each student

IV. Procedure:

A. Band I - Written Drill Involving Patterns

1. Have this drill written on the board for students to do when they come into class.

2. Drill: What Comes Next?

a. 1, 2, 4, 8, ___, ___, ___, ___

b. 20, ___. 30, ___, 40, 45, ___, ___, ___

c. 38, 35, 32, ___, ___, ___, ___, ___

d. 20, ___, 26, 29, ___, ___, 38, ___

3. Identify patterns and answers with students.

4. Have student place his score in the margin of his paper (same as in previous lessons).

5. Students should use the drill paper in their notebooks.

B. Band II - Midpoint of a Line Segment

1. Have about six segments of different sizes drawn on the chalkboard (in various positions).

2. Explain that some points of a segment are given special names because of their location.

3. Ask students if they can name one of these special points. (end point)

4. Have students come up and color each end point of segments with colored chalk.

5. Introduce the fact that every segment has at least one other special point. This special point is called midpoint. (Write the name on the board and have the class pronounce it.)

6. Ask students if they think they can locate the midpoint in one of these segments.

7. Have students locate midpoints on remaining segments.

8. Ask students how they located the midpoints.

9. Ask students how many different ways they can think of to locate the midpoint accurately.

   a. paper folding

   b. measuring

   c. compass and straightedge

10. Let's see how we can find midpoints of segments by paper folding. Distribute pieces of paper to each student.

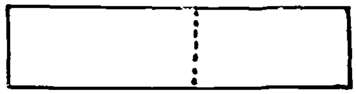
11. Let students experiment by folding paper to locate midpoints.

12. Use marking pencils for marking midpoints and end points.

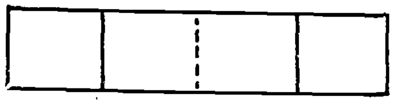
C. Band III - Constructing A Ruler

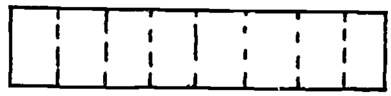
1. Give each student a piece of paper 8" long, 1" wide. Have students measure desks and give their results, e. g. 2 lengths plus a little. The students should recognize a need for a more precise scale.

2. Have students fold paper in half. Repeat measurements.



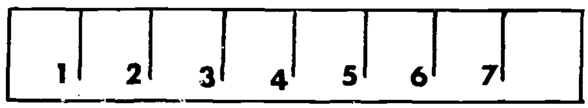
3. Have students continue folding in half until 8 units are designated.



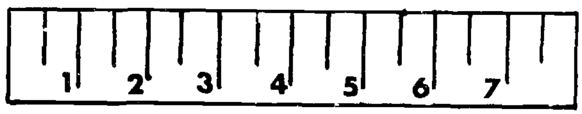


4. Have students color each of the creases black and number them. Then students should be able to make measurements more precisely.

Note that each unit is really 1".



5. By folding each unit in half the scale is marked off in half inch intervals. Mark this in red so that these lines are slightly shorter than the black lines.



6. Give students pieces of railroad board 8" long and 1" wide. The paper ruler will be pasted to the railroad board to make handling of the ruler easier.

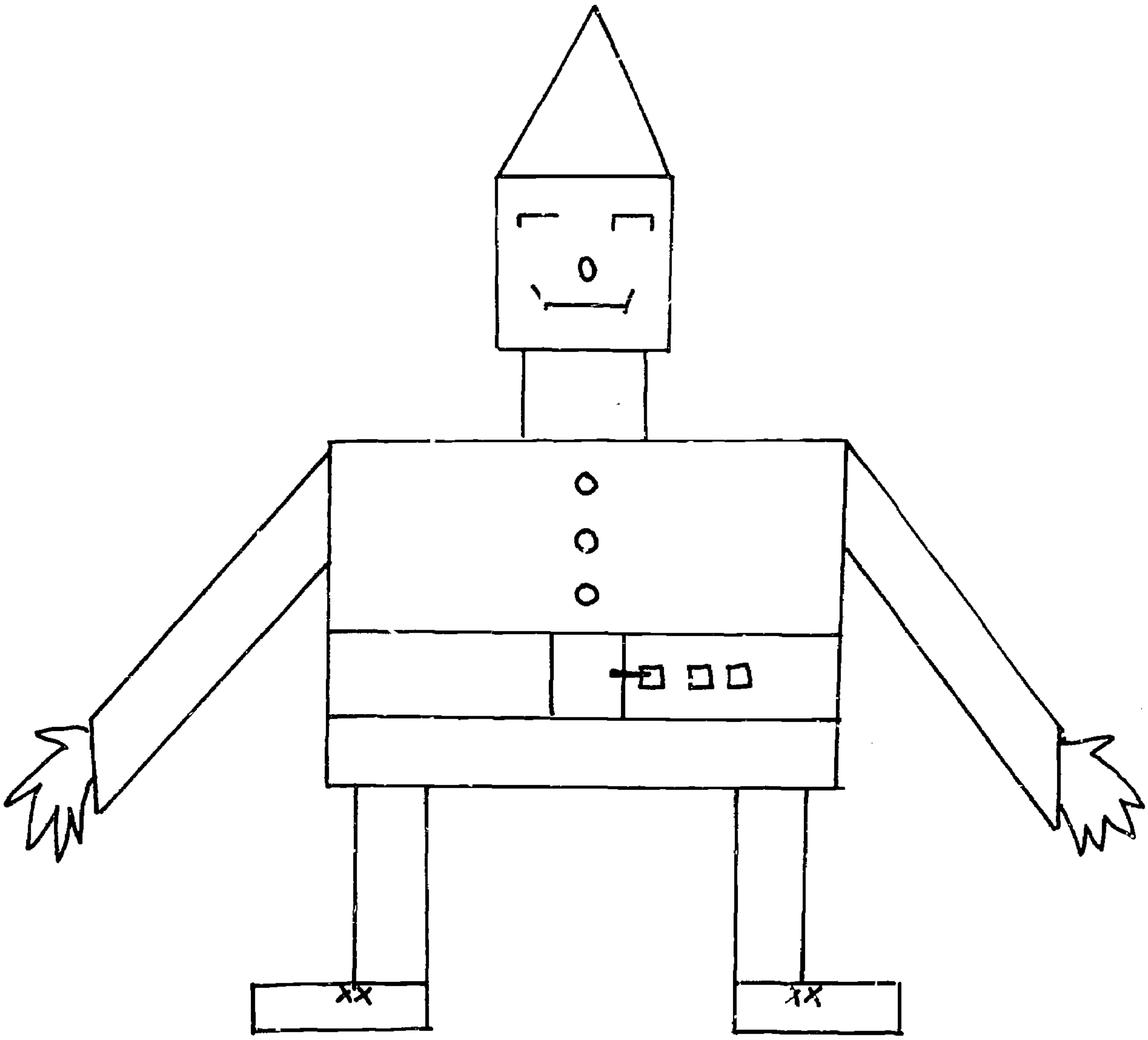
7. Give students the work sheet entitled, "Tommy Tin Man." Let them use rulers to answer the eight questions.

Solution:

a. 1"	e. 1"
b. 2"	f. $\frac{1}{2}$"
c. 6"	g. 1"
d. 2"	h. 1"

TOMMY TIN MAN

Tommy is a Tin Man
But one thing is a must,
He always needs an oil can
So he will not rust.



a. How high is Tommy Tin's hat? ______

b. How wide is Tommy? ______

c. How tall is Tommy? ______

d. How long is each sleeve? ______

e. How long is each shoe? ______

f. How wide is Tommy's belt? ______

g. How long is Tommy's face? ______

h. How wide is Tommy's face? ______

LESSON 7

I. Unit: Geometry

II. Objectives: The student should be able to:

A. Describe a midpoint

B. Demonstrate a method for determining the midpoint of a line segment by using a compass and straightedge

III. Materials:

A. Band I

1. Math Builder

2. Filmstrip - ML-AR (Series) 3

B. Band II

1. Compass and straightedge

2. Work sheet entitled, "Finding the Midpoint of a Segment"

3. Ruler and pencil

4. Work sheet entitled, "Finding Midpoints - Exercises"

C. Band III - None

IV. Procedure:

A. Band I - Number Patterns Using the Math Builder, film ML-Ar-3

1. Have students number their drill papers as follows:

Exercise C	Exercise D
A	A
↓	↓
J	J

2. Check Exercise C before going to Exercise D.

3. Increase speed when students do Exercise D.

B. Band II

1. Review

a. Name and identify midpoint.

b. Describe a method for finding midpoints learned in previous lesson.

2. Tell the students that today they are going to locate the midpoint of a segment using a different method. To do this they will need a straightedge, compass, and penci

3. Distribute the work sheet entitled, "Finding the Midpoint of a Segment."

4. Ask them to see if they can follow the directions given on the sheet to find the midpoint of a line segment by the second method.

5. The overhead projector may be very helpful at this point.

6. When students have completed the sheet on finding midpoints, give them the work sheet entitled, "Finding Midpoints."

7. If you find that some students finish very quickly, let them help those students who are having difficulties.

C. Band III - Puzzle Involving Division, Addition, Multiplication, and Subtraction

1. Have each student write a number.	1. 1
2. Have him multiply his number by 6.	2. $1 \times 6 = 6$
3. Tell him to add 12 to his product.	3. $6 + 12 = 18$
4. Divide the sum by 2.	4. $18 \div 2 = 9$
5. Subtract 6 from the quotient.	5. $9 - 6 = 3$

6. Have students, one at a time, tell you their answers. You can tell him his original number.

Solution:

a. Divide the final result by 3 to get the original number.

b. From the example:

The final answer = 3.

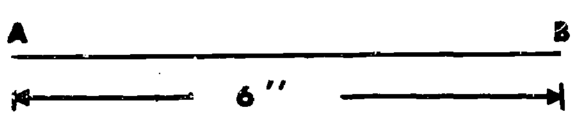
$3 \div 3 = 1$, which is the original number.

FINDING THE MIDPOINT OF A [illegible]

See if you can follow these directions to find the midpoint of the following segment.

---

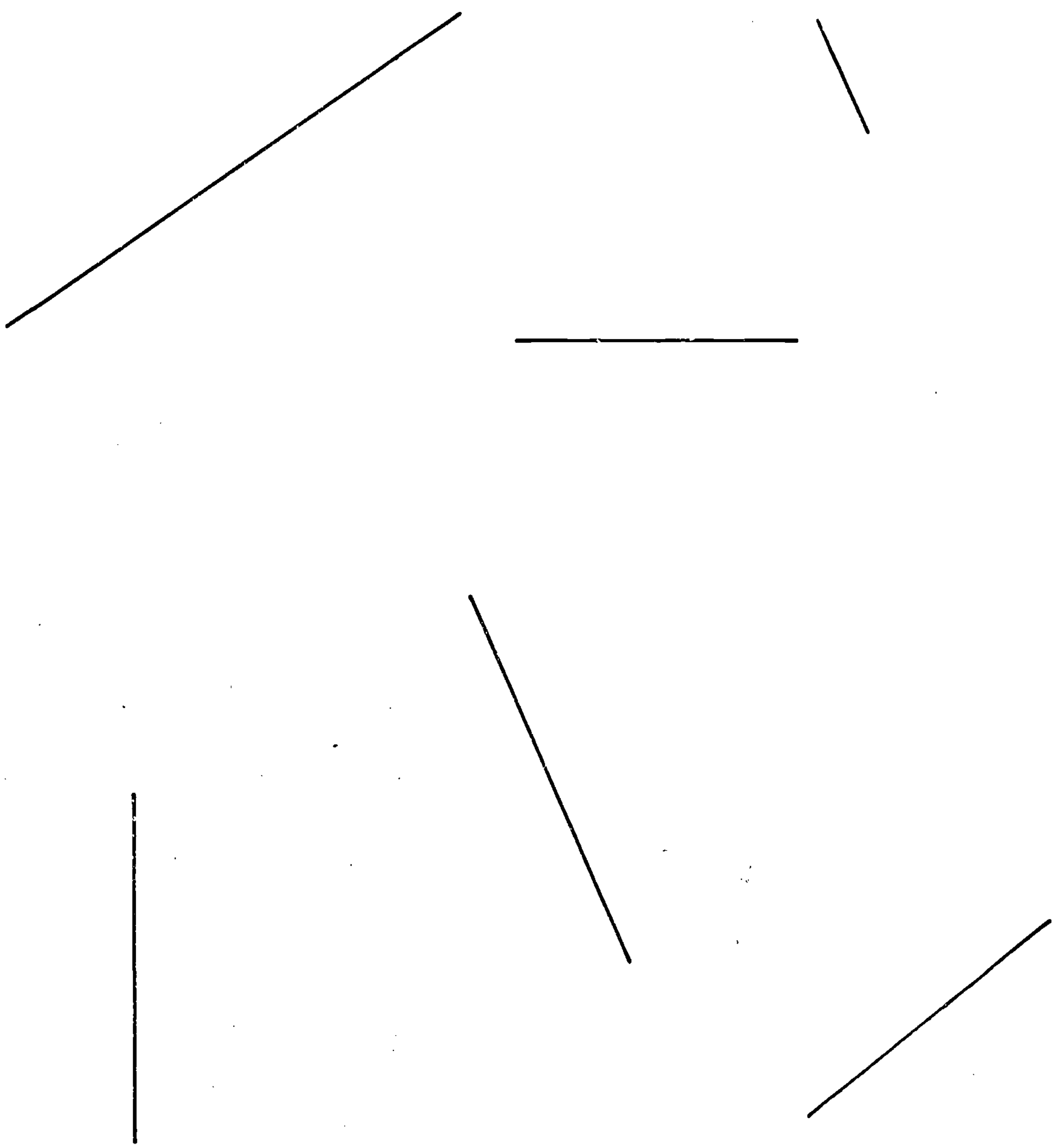
1. Label the end points of this segment A and B.
2. The length of the segment is ________ inches.
3. Open your compass to more than half the measure of the line segment.
   a. Place the point on A.
   b. Make one arc above the segment and one below.
4. Do not change the compass setting.
   a. Place the point at B.
   b. Make two more arcs, each intersecting the first ones.
5. Label the points where the marks intersect D and E
6. Connect points D and E.
   Name the segment. ____________
7. Does segment $\overline{DE}$ cross $\overline{AB}$? ____________
8. Label the point where $\overline{AB}$ and $\overline{DE}$ intersect M.
9. What is the length of $\overline{AM}$? ____________
10. What is the length of $\overline{MB}$? ____________
11. What special name do we give to point M? ____________
12. Suppose the length of $\overline{AB}$ had been 6 inches.



The midpoint is ________ inches from A.
Call the midpoint M. What is the length of $\overline{MB}$? ____________

FINDING MIDPOINTS

Use your compass and straightedge to find the midpoint of the following segments.



LESSON 8

I. Unit: Geometry

II. Materials:

A. Band I - None

B. Band II

1. Work sheet entitled, "Quiz on Midpoints"

2. Straightedge and compass

3. Scissors and pencil

C. Band III - Work sheet entitled, "Cross Number Puzzle Involving Multiplication"

III. Procedure:

A. Band I - Puzzle Involving Division

1. Have each student write a number.	1. 2
2. Have him multiply his number by 6.	2. $2 \times 6 = 12$
3. Tell him to add 12 to hi product.	3. $12 + 12 = 24$
4. Divide the sum by 3.	4. $24 \div 3 = 8$
5. Subtract 2 from this quotient.	5. $8 - 2 = 6$
6. Divide the difference by 2.	6. $6 \div 2 = 3$
7. Subtract the original number from this quotient.	7. $3 - 2 = 1$
8. Add 9 to this remainder.	8. $1 + 9 = 10$

Solution:

The answer is always 10.

B. Band II - Assessment for Finding Midpoints

Have students complete the quiz and then carefully check their work.

C. Band III

As students complete the exercise in Band II, have them turn in their papers and go get a cross number puzzle from the rear of the room. This will eliminate restlessness among students who have completed their assignments and have nothing to do.

D. Band III- Cross Number Puzzle

Solution:

2	4		1	8		3	6
1	6		2	7		3	7
5	0		4	0		3	2
		6	0		1	3	
	1	6		5	5		
4	4		3	0		2	8
3	2		6	4		2	9
5	0		5	0		2	9

QUIZ ON MIDPOINTS

A.

1. Cut out the strip of paper.
2. Fold the strip to locate the midpoint of $\overline{AB}$.
3. Label the midpoint of $\overline{AB}$ point M.
4. Now fold your paper again to find the midpoint of $\overline{AM}$ and call it P.
5. Find the midpoint of $\overline{MB}$ and call this midpoint Q.

B. Directions: Use the strip of paper to complete the following.

1. M divides $\overline{AB}$ into ____________ equal parts.
2. Point _________ is called the midpoint of $\overline{AB}$.
3. The length of $\overline{AM}$ is _________ inches; the length of $\overline{MB}$ is ________ inches.
4. P is the midpoint of _________; Q is the midpoint of ________.

C. Complete the following:

1. Point T is the midpoint of $\overline{XY}$.

   The length of $\overline{XY}$ is 2 inches.

   What is the length of $\overline{XT}$? _______________

   What is the length of $\overline{TY}$? _______________

2. The length of segment $\overline{EF}$ is 6 inches.

   The midpoint is ________ inches from E.

   If the midpoint is Q, what is the length of $\overline{QF}$? ______________

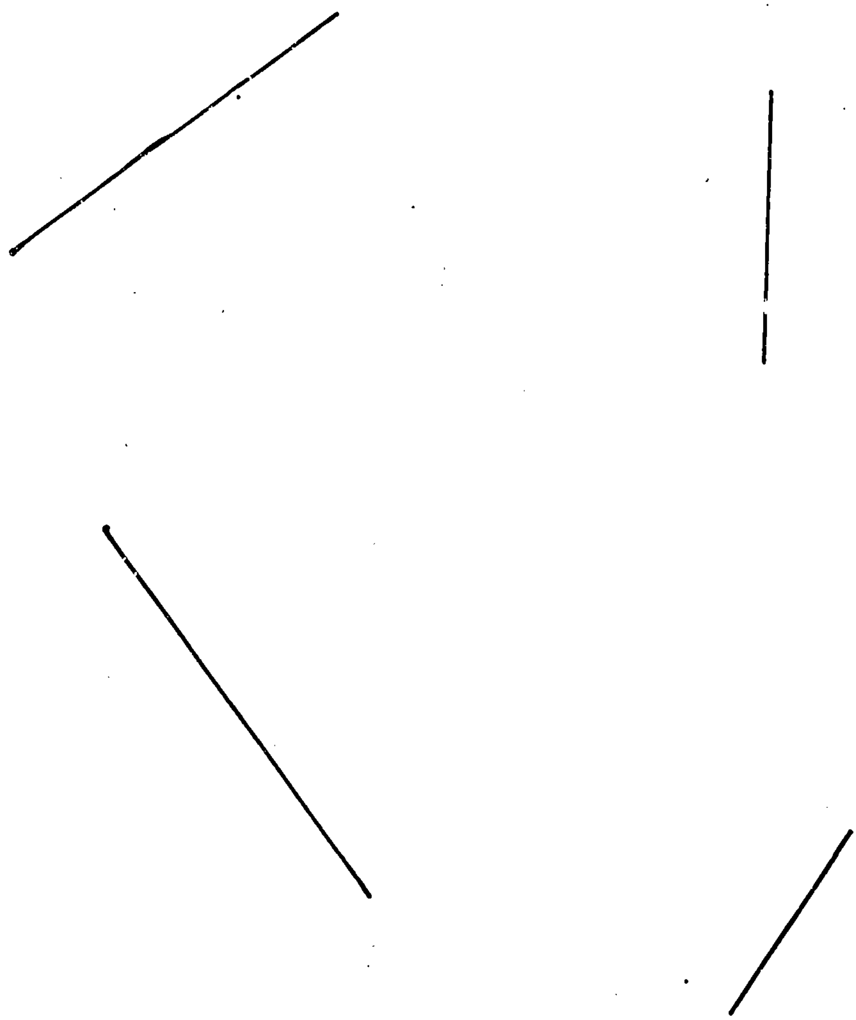
3. The length of $\overline{DC}$ is 12 inches. The distance from the midpoint to D is _________ inches.

4. This represents $\overline{LM}$.

The midpoint, "O," is 5 inches from L. How long is $\overline{LM}$? __________

5. If the midpoint, "S, " is 7 inches from R in $\overline{RT}$, what is the length of $\overline{RT}$? ______________

D. Use your straightedge and compass to find midpoints of the following. Label your midpoints.



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CROSS NUMBER PUZZLE

a	b	■	c	d	■	e	f
g		■	h		■	i	
j		■	k		■	l	
■	■	m		■	n		■
■	o		■	p		■	■
q		■	r		■	s	t
u		■	v		■	w	
x		■	y		■	z	

Across

a. 6 x 4 =

c. 9 x 2 =

e. 3 x 12 =

g. 2 x 8 =

h. 3 x 3 x 3 =

i. 4 x 9 + 1 =

j. $\frac{1}{2}$ dollar in cents

k. 4 tens

l. 3 tens + 2

m. 10 sixes

n. thirteen

o. 4 x 4 =

p. 9 x 6 + 1 =

q. 6 x 7 + 2 =

r. thirty

s. 3 tens - 2

u. 3 tens + 2

Down

a. 5 x 43 =

b. 46 x 10 =

c. twelve hundred forty

d. 290 x 3 =

e. 111 x 3 =

f. 112 x 6 =

m. $5\frac{1}{2}$ dozen

n. 2 tens minus 5

o. 284 x 5 =

p. Sum of column is 9?

q. Four hundred thirty-five

r. Number of days in a year

s. 74 x 3 =

t. 8 dollars, 9 dimes, 9 cents

Across

v. 8 x 8 =

w. 4 sevens + 1 =

x. 10 fives

y. 5 dimes

z. 8 fours minus 3

LESSON 9

I. Unit: Geometry

II. Objectives: The student should be able to:

A. Name and identify the symbol for an angle

B. Name and identify the vertex of an angle

C. Describe a vertex as the point where the two rays meet

III. Materials:

A. Band I

1. Math Builder

2. Filmstrip - ML-AR (Series) 3

B. Band II

1. Straightedge and pencil

2. Work sheet entitled, "Angles and Vertex"

C. Band III

1. Red and blue pencils

2. Work sheet entitled, "Numbers Have Many Names"

IV. Procedure:

A. Band I - Number Patterns (Series) Using Math Builder

1. Have students number their drill papers as follows:

Exercise E

a.
↓
j.

2. Check exercise after completion.

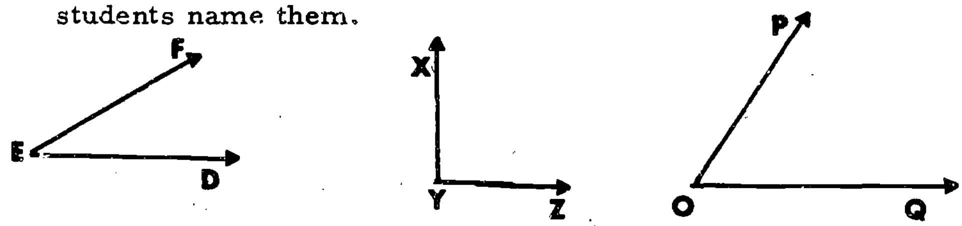
B. Band II - Angle and Vertex

1. Tell students you are thinking of a geometric figure that is made up of two rays with a common end point. What figure am I thinking of? (Angle)

2. Ask students to name some physical representations of angles.

3. Write the word angle on the chalkboard and have students draw a representation of it.

4. Name the angle using the symbol, ∠ ABC or ∠ CBA.
5. Emphasize that the center letter must always name the common end point.
6. Draw the following angles on the chalkboard and have students name them.



7. Have students draw various angles using a ruler or a straightedge. Then write the name of the angle using the symbol.
8. Identify the parts of an angle: e.g. sides, vertex
9. Identify the common end point as the vertex.
10. Write the word vertex on the board.
11. Have a student come to the board and point out the vertices of the angles drawn in No. 6.

C. Band III - Numbers Have Many Names

1. Have students complete work sheet entitled, "Numbers Have Many Names."
2. Check to see that students understand directions. Give help where needed.
3. Solution:

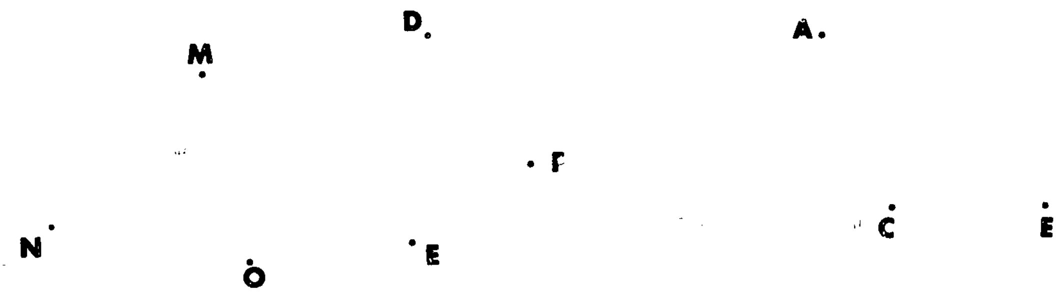
For 17		For 10	
24 - 7	5 + 5 - 0 + 7	3 + 7	4 + 3 + 2 + 1
$\frac{1}{1}$ x 17	0 + 17	3 x 3 + 1	46 - 36
117 - 100	51 ÷ 3	10 + 0	X
8 + 9	27 - 10	40 - 30	
Seventeen	21 - 4	100 - 90	
(30 + 4) ÷ 2		10 - 0	
15 + 2		15 + 6 - 11	
17 x 0		1 x 10	
$\frac{34}{2}$		Ten	
		(6 x 2) - 2	

ANGLES AND VERTEX

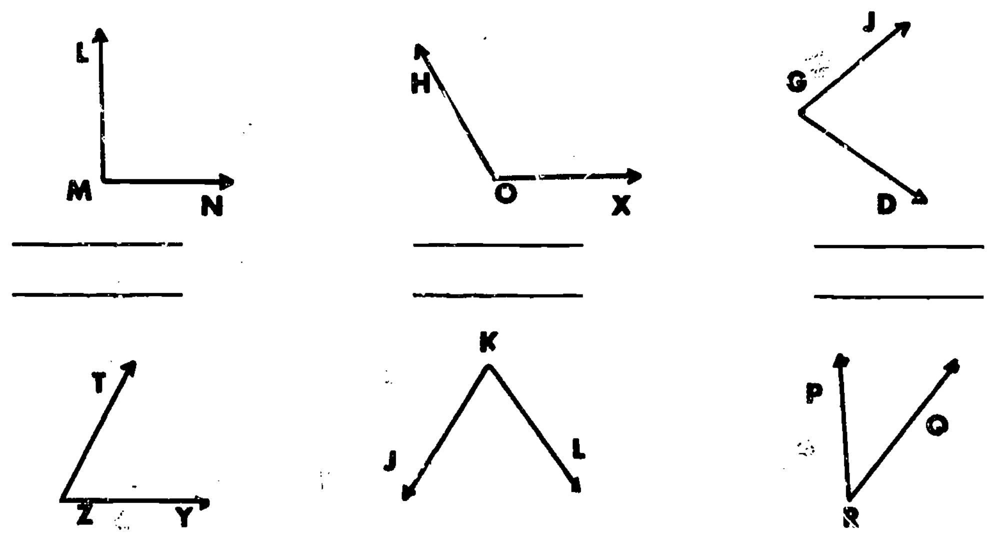
Directions:

A. Use your straightedge to draw the following angles.

1. ∠MON 2. ∠FED 3. ∠ACE



B. Name the vertex of each angle below. Write the name of each angle.



NUMBERS HAVE MANY NAMES

Directions: Study the many names for numbers listed on this paper.

I. Using a <u>red</u> pen or pencil, draw <u>a circle around</u> each name for 17.

II. Using a <u>blue</u> pen or pencil, draw <u>a line under</u> each name for 10.

$100 + 90$ 3×7 $40 - 30$ $24 - 7$

$17 + 7$ $10 + 0$ $100 - 90$ $\frac{34}{2}$

Seventy

$\frac{17}{10}$ $3 \times 3 + 1$ $1 \times 2 + 3 + 4$ $\frac{1}{1} \times 17$ $5 \times 4 - 3$

71 $1 + 0$ $(30 + 4) \div 2$ $117 - 100$

SEVEN 17×0 $15 + 2$

$(6 + 2) \div 2$ $0 + 17$

$5 + 5 - 0 + 7$ X $21 - 4$ $10 - 0$

30×70 1×10 $8 + 9$

$27 \div 2$ SEVENTEEN $51 \div 3$

$15 + 6 - 11$ 5×5 TEN

$46 - 36$ $4 + 3 + 2 + 1$ $31 - 18$ $27 - 10$

LESSON 10

I. Unit: Geometry

II. Objectives: The student should be able to:

Demonstrate the construction of a copy of an angle by using a compass and straightedge

III. Materials:

A. Band I

1. Tape - Verbal Problems I

2. Tape recorder

3. Pencil and paper

B. Band II

1. Straightedge

2. Compass

3. Work sheet entitled, " ∠ Copier"

4. Pencil

C. Band III - None

IV. Procedure:

A. Band I

1. Have student get out his drill paper and number as follows:

1.	6.	11.
2.	7.	12.
3.	8.	13.
4.	9.	14.
5.	10.	15.

2. Turn on the tape, "Verbal Problems I," and have children follow directions from the tape.

B. Band II - Angle Copier

1. Review:

a. Naming an angle

b. Identifying the vertex of an angle

c. Describing the vertex of an angle as the point where two rays meet

2. Tell the students that yesterday they were given practice drawing and naming angles. Today they are to copy an angle.

   To do this, they will need a compass, a straightedge and a pencil.

3. Give each student a work sheet entitled, "∠ Copier."

4. Ask students to see if they can follow the directions given on the sheet to copy the angle.

5. The use of the overhead projector may be helpful at this point.

6. When students have completed the discovery exercises, let them copy the two angles on page 2 of the work sheet.

7. If you find some students finish very quickly, let them help those students who are having difficulties.

C. Band III - Tic-Tac-Toe Game

1. Have a Tic-Tac-Toe diagram on the board to use in explaining the rules of the game.

2. Game rules:

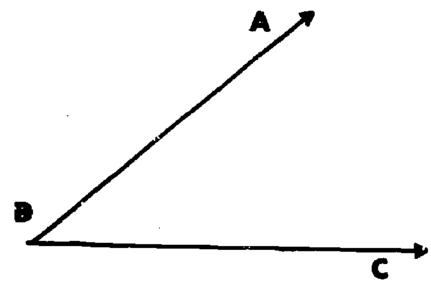
   a. This game is played by two people using the ordinary tic-tac-toe diagram. The players take turns alternately. When it is his turn a player chooses one of the digits 1-9. Each digit can be used only once. The player places his digit in any unfilled cell of the diagram.

   b. The player's goal is to make the sum of three digits in any row, column, or diagonal equal 15.

   c. The player who first makes the sum of three digits in any row, column, or diagonal something other than 15 loses the game.

∠ COPIER

See if you can copy ∠ABC.



Begin with $\overrightarrow{DE}$, shown below.

1. Let D be the vertex of the new angle.

   Try to picture how the new angle will appear.

2. Set the compass at an opening of about $1\frac{1}{2}$ inches.
3. Place the point of your compass on B.
4. Make an arc which crosses both sides of ∠ABC.
5. Lift your compass from B, being careful not to change the setting.
6. Label the point where the mark crosses $\overrightarrow{BC}$, P.
7. Label the point where the mark crosses $\overrightarrow{BA}$, Q.
8. Now place the point of your compass on D.
9. Again make an arc which is as long as the mark you made on ∠ABC and which crosses $\overrightarrow{DE}$.

10. Label the point where the mark crosses $\overrightarrow{DE}$, R.

11. Put the point of your compass on P and the pencil point of your compass on Q.

12. Lift your compass, being careful to keep it open the distance from P to Q.

13. Place the point of your compass on R.

14. Make another mark which crosses the mark made in step 9 above.

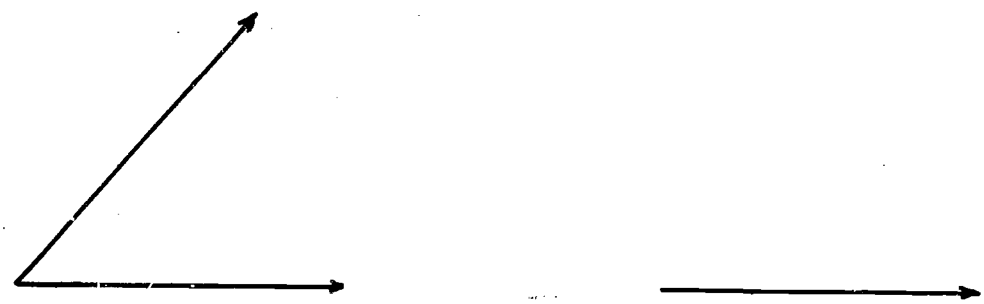
15. Label the point where the two marks cross, S.

16. Draw $\overrightarrow{DS}$.

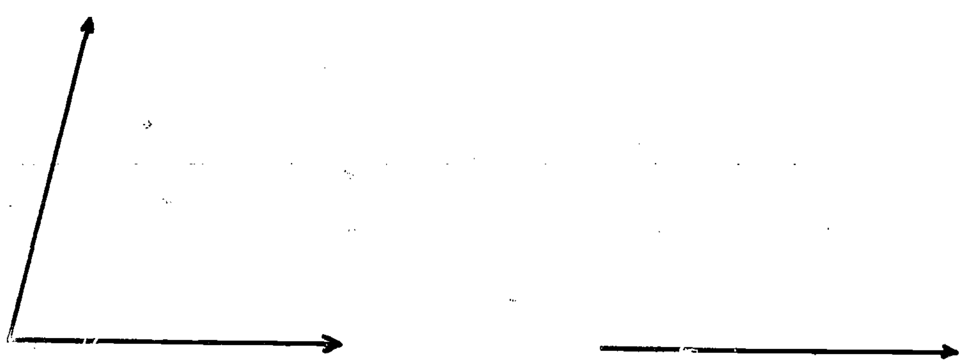
The angle you have copied is named ____________.

Now see if you can copy these two angles.

1.



2.



LESSON 11

I. Unit: Geometry

II. Materials:

A. Band I

1. Work sheet entitled, "Diagnostic Test on Addition of Whole Numbers"

2. Work sheet entitled, "Find the Missing Number"

3. Pencils

B. Band II

1. Straightedge and compass

2. Work sheet entitled, "Copying an ∠"

3. Pencils

C. Band III

1. Paper

2. Pencil

III. Procedure:

A. Band I - Diagnostic Test 1 - Addition of Whole Numbers

1. Tell the students that this diagnostic is the first of four that will be given to them involving whole numbers. The purpose of these tests are for them to see with which operations they need help.

2. Encourage students to take their time and to do their best. Tell them that a low score on this will not count against them on report cards.

3. Have students take the test. After each student has checked over his test, collect it and have him go pick up a copy of the work sheet entitled, "Find the Missing Number" from the rear of the room.

Solutions:

	24		
57	32	89	874
+ 22	+ 71	- 46	- 52[illegible]
79	127	33	353

12	219	$\begin{array}{r} 32 \\ 4\overline{)128} \\ \underline{12} \\ 8 \\ 8 \end{array}$	$\begin{array}{r} 65 \\ 6\overline{)390} \\ \underline{36} \\ 30 \\ 30 \end{array}$
$\underline{\times 3}$	$\underline{\times 4}$		
36	876		

4. Follow-up activities on the diagnostic tests will be done in the next lesson.

   Solution for Diagnostic Test:

   1. 78 6. 91
   2. 92 7. 16
   3. 9 8. 25
   4. 17 9. 30
   5. 99 10. 322

C. Band III

1. Students will work with another student to complete the Tic-Tac-Toe Game begun by some in last lesson.
2. For those students who did not begin it in the previous lesson, make sure directions are clear before they begin.
3. Have a diagram of the Tic-Tac-Toe on the board in case the rules have to be explained once more.

ADDITION OF WHOLE NUMBERS | Diagnostic Test 1

Name ______________________________ Class ______________

Solve the following addition problems.

1. 45 33	2. 55 37	3. 6 2 1	4. 6 8 3
5. 45 23 31	6. 34 12 45	7. 7 2 4 3	8. 9 6 4 6
9. 4 5 6 8 7	10. 99 42 38 86 57		

FIND THE MISSING NUMBER

Can you find the missing numbers in each of these examples? When you use a number, cross it out. See if you can use each number correctly.

8 6 2 7 8 4

2 0 3 6 3 2 2

3 4 7 8 2 2

8 6 0

1.
```
  5 7
+ _ _
-----
  7 9
```

2.
```
  2 4
  3 _
+ _ 1
-----
1 2 7
```

3.
```
  _ 9
- 4 _
-----
  3 3
```

4.
```
  8 7 _
- 5 _ 1
-------
  _ 5 3
```

5.
```
  1 _
x   3
-----
  _ 6
```

6.
```
  2 1 9
x     4
-------
  _ _ 6
```

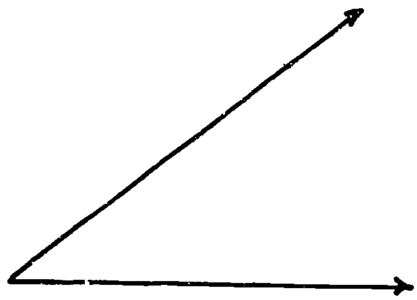
7.
```
     3 _
_ )1 2 8
   1 2
   ---
     _
     _
     -
```

8.
```
    6 5
_ )3 9 0
   3 _
   ---
     3 _
     _ _
     ---
```

COPYING AN ANGLE

Copy each of these six angles on another piece of paper. Use your compass and straightedge.

1



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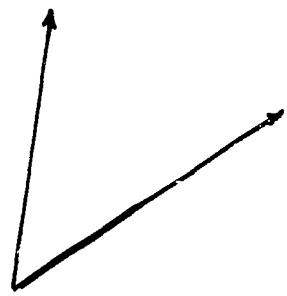

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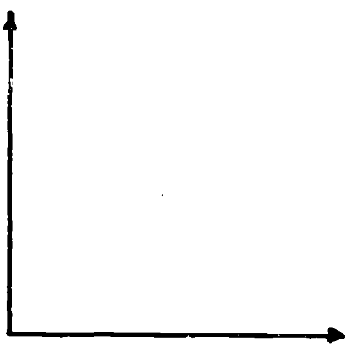
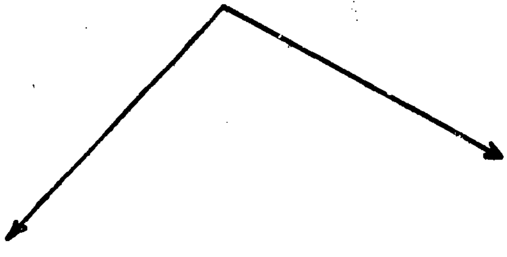


4

5



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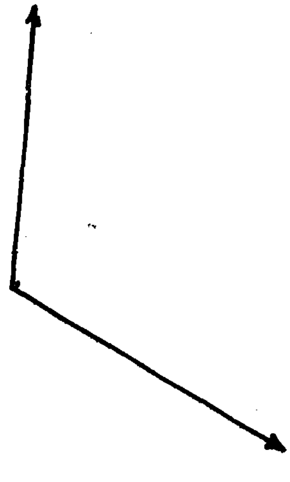


LESSON 12

I. Unit: Geometry

II. Materials:

A. Band I - Calendar showing current month

B. Band II

1. Work sheet entitled, "Copying an $\angle$-II"

2. Straightedge

3. Compass

C. Band III - Work sheet entitled, "Find the Hidden Word"

III. Procedure:

A. Band I - Puzzle Involving Addition

1. Hang the calendar in the front of the room so the students can see the days for a whole month.

2. Have the students add the days of the first week together. Compare their results.

3. Have the students add the dates in the second week. The first student getting an answer raises his hand. Compare results.

4. Tell students there is a short way for adding dates in any week.

a. Take the number of the first day and multiply by 7.

b. Add 21 to this number.

5. Have students go back and use the short cut to find the sum of the dates in the 3-4 weeks.

B. Band II - Assessment on Copying Angles

1. Have students complete the work sheet entitled, "Copying an $\angle$-II."

2. As students complete the exercise, have them turn in their papers.

C. Band III - Puzzle - Find the Hidden Word

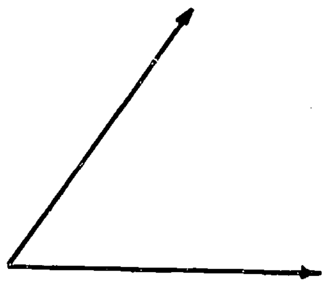
1. The work sheet entitled "Find the Hidden Word" should be placed in the work corner for student to begin working as soon as he has completed the work sheet from Band II.

2. Observe students working with this puzzle to make sure they are completing it correctly.

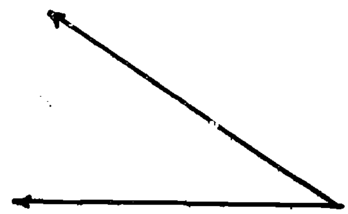
COPYING AN $\angle$ -II

Directions: Copy the following $\angle$s, using a compass and straightedge.

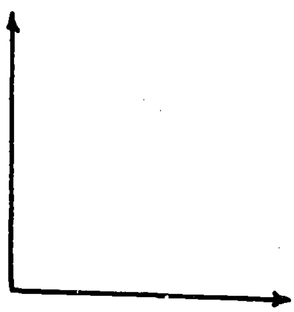
1



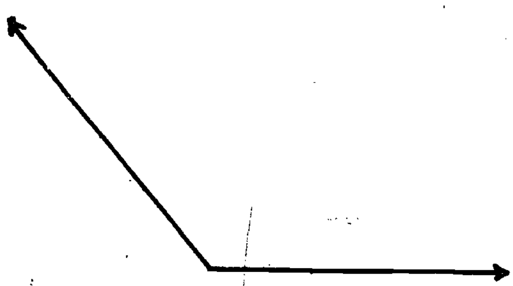
2



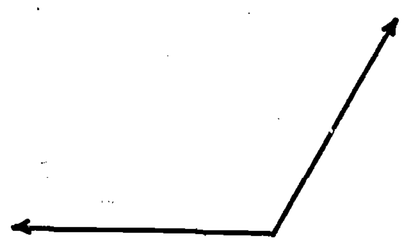
3



4

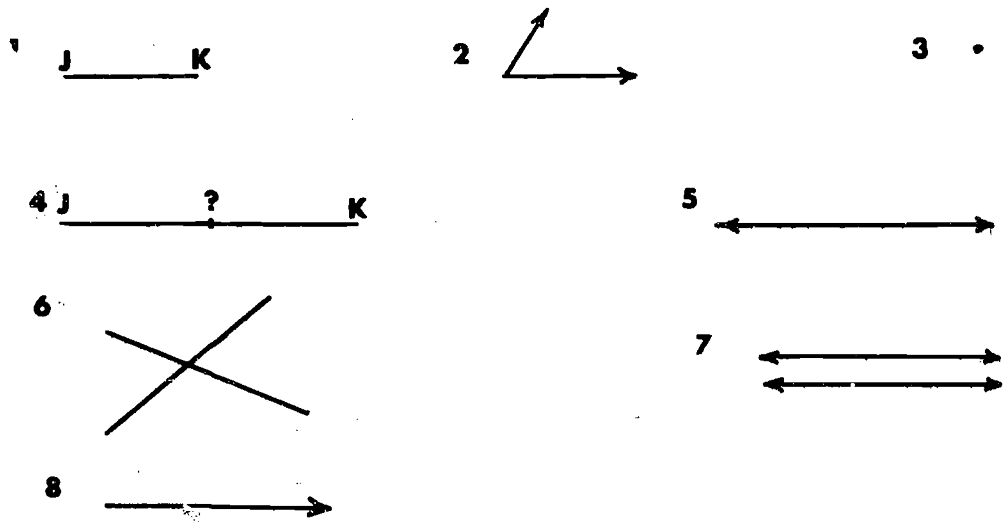


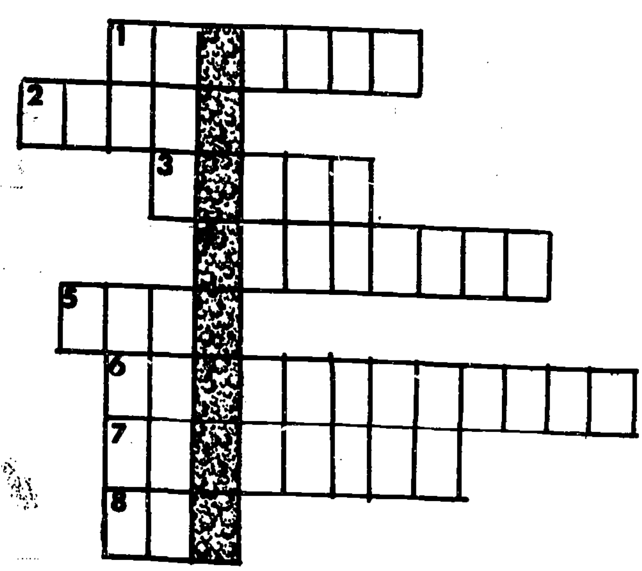
5



FINDING THE HIDDEN WORD

Fill in the puzzle with the name of each symbol shown. If you do this correctly, the hidden word will be seen.





RESOURCE MATERIALS

A. Books

Adler, Irving. The Giant Golden Book of Mathematics. New York: Golden Press. 1958

Bergamini, David. Mathematics, Life Science Library. New York, N. Y.: Time, Inc. 1963

Heddens, James M. Today's Mathematics. Chicago: Science Research Associates, Inc. 1963

Highland, H. J. The How and Why Wonder Book of Mathematics. New York: Wonder Books. 1963

Hughes, Toni. How to Make Shapes in Space. New York: E. P. Dutton and Co., Inc. 1955

Johnson, Pauline. Creating With Paper. Washington: University of Washington Press. 1958

Morris, Dennis and Topfer, Henry. Advancing in Mathematics, Grade 7. Chicago: Science Research Associates, Inc. 1963

Morris, Dennis and Topfer, Henry. Advancing in Mathematics, Grade 8. Chicago: Science Research Associates, Inc. 1963

Northrop, Eugene P. Riddles in Mathematics. New York: D. Van Nostrand Co., Inc. 1944

Wirtz, Robert; Botel, Morton and Nunley, B. G. Discovery in Elementary School Mathematics. Chicago: Encyclopaedia Britannica Press, Inc. 1963

Young, Mary. Singing Windows. New York: Abingdon Press. 1962

B. Pamphlets and Periodicals

Amir-Mo-Az. Ruler, Compasses and Fun. New York: Ginn and Co. 1966

Bazdon, Jack and Murtin, Mark. Cross Number Puzzle Boxes. Chicago: Science Research Associates, Inc. 1966

Criflinski, Henry. Modern Mathematics, Ditto Workbooks. Washington, D. C.: Hayes School Publishing Co. 1964

Herrick, Marian C. Modern Mathematics for Achievement. New York: Houghton Mifflin Co. 1966

Johnson, Donovan. Paper Folding for the Mathematics Class. Washington, D. C.: National Council of Teachers of Mathematics. 1957

Johnson, Donovan A. and Glenn, William H. Topology: The Rubber-Sheet Geometry. Atlanta: Webster Publishing Co. 1960

Larson, Harold. Enrichment Program for Arithmetic Grades 3-8: Elmsford, New York: Harper and Row Publishers. 1963

Murray, William D. and Rigney, Francis. Paper Folding for Beginners. New York: Dover Publications, Inc. 1960

Potter, Mary and Mallory, Virgil. Education in Mathematics for the Slow Learner. Washington, D. C.: National Council of Teachers of Mathematics. 1958

Proctor, Charles and Johnson, Patricia. Computational Developmental Skills Kit. Chicago: Science Research Associates, Inc. 1965

School Mathematics Study Group. Conference on Mathematics Education for Below Average Achiever. Pasadena, California: Vroman Co. 1964

Topics in Mathematics for Elementary School Teachers. Washington, D. C.: National Council of Teachers of Mathematics. 1964

Wirtz, Robert and Botel, Morton. Math Workshop, Levels A-F. Chicago: Encyclopaedia Britannica Press, Inc. 1961

Woodby, Lauren. The Low Achiever in Mathematics. Washington, D. C.: U. S. Office of Education. 1964

C. Games

Milton Bradley Co., Springfield, Mass.
"Primary Peg Board #474X"
Pegs #472X or #475X

Edmund Scientific, Barrington, New Jersey 08007
"Dr. Nim" ($2.98)
"Probability Kit" ($4.00)
"Soma" ($2.00)

Ideal Supply Co., 11315 Watertown Plank Road, Milwaukee, Wis. 53201

"Geometric Wire Forms and Patterns #794" ($3.00)

Kohner Bros., Inc., 155 Wooster Street, New York, N.Y. 10012

"Euclid" ($1.00)
"Hexed" ($1.00)
"Hi-Q" ($1.00)
"Kwazy Quilt" ($1.00)
"Pythagoras" ($1.00)
"Tormentor" ($1.00)
"Voodoo" ($1.00)

Krypto Corporation, 2 Pine Street, San Francisco, California 94111

"Krypto" ($3.95)

Parker Bros., Inc., P. O. Box 900, Salem, Mass.

"Take Twelve" ($1.00)

Science Research Associates, 259 East Erie Street, Chicago, Illinois 60611

"Equations" ($3.00)
"Cross Number Puzzles" ($22.75)

D. Films

Baltimore County Central Film Library

Probability, McGraw Hill Book Co.

Mean, Median and Mode, McGraw Hill Book Co.

NUMBERS, OPERATIONS AND ALGORITHMS

NUMBERS, OPERATIONS AND ALGORITHMS

I. Master Chart - Grades Six through Eleven

II. Grade Seven Chart and Behavioral Objectives

- A. Whole Numbers
- B. Fractional Numbers - Preliminary Topics
- C. Multiplication of Fractional Numbers
- D. Division of Fractional Numbers
- E. Addition of Fractional Numbers
- F. Subtraction of Fractional Numbers
- G. Decimal Numerals
- H. Square Root

III. Activities

UNIT WHOLE NUMBERS GRADE(S) Six through Ten

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Numerals to Millions	6	6	6						6	6
Numerals to Billions	7	7	7						7	7
Rounding to Millions	6	6	6				6			6
Rounding to Billions	7	7	7				7			7
Expanded Notation to Millions	6	6	6			8				
Expanded Notation to Billions	7	7	7			8	7			
Renaming Numbers	6	6	6			8	6			
Vocabulary	6	6								6
Place Value to Millions	6	6								
Place Value to Billions	7	7								
Denominate Numbers		6	6		6	7	6			
Verbal Problems			6, 7, 8	6, 7, 8				6, 7, 8		
Betweenness			6, 7		6					
Symbol(s)	6, 7, 8	6, 7, 8		6, 7, 8						
Number Sentences	6	6	6		6		6			
Vertical Form Addition			6, 7, 8	6, 7, 8						
Using Number Line	6		6	6	6		6			
Basic Facts	6	6	6							

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UNIT WHOLE NUMBERS GRADE(S) Six through Ten

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Number Patterns			6	6	6		6			
Estimation			7	7	7		7			
Casting Out Nines	8		8		8		8			
Closure	8				6	9				
Commutative Property	8	6	6		6	9	6			8
Associative Property	8	6	6		6	9	6			8
Identity Element	9	6	6		6	7	6			
Inverse Operations		7	6		7	10	6			
Vertical Form Subtraction			6, 7, 8	6, 7, 8						
Checking			6		6					
Role of Zero			6		6	7	6			
Order of Operations			6, 8		6, 8	10	6, 8			
Vertical Form Multiplication			6, 7, 8	6, 7, 8						
Factoring		6	6							
Divisors	6	6	6							
Rules for Divisibility						6, 7, 8	6, 7, 8			
Prime Numbers	7	7	7							7
Composite Numbers	7	7	7		7					

UNIT WHOLE NUMBERS GRADE(S) Six through Ten

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Prime Factorization	7	7	7	7	7					7
Multiples	7	7		7	7					8
Power	7	7	7	7	7				8	
Base	7	7	7		7					
Exponent	7	7	7		7					
Distributive Property	9	9	9			10	6			
Division			6, 7, 8	6, 7, 8						
Remainders	6	6			6					
Role of One			6		6	7	6			

PRELIMINARY TOPICS OF FRACTIONAL NUMBERS

UNIT FRACTIONAL NUMBERS   GRADE(S) Six through Nine

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Meaning of Fractions	6	6	6		6	8				
Numerator and Denominator	6	6			6					
Symbols (Fraction Bar)	6	6			6	6				
Number Line	6, 7, 8	6, 7, 8	6, 7, 8	7, 8	8					
Comparing Fractions			6	6					6	
Divisibility Rules		6, 7, 8	6, 7, 8			6, 7, 8	6, 7, 8, 9			6, 7, 8
Fractional Names for One	6	6	6	6	6	8	7			
Greatest Common Factor	7, 8, 9	7, 8, 9	7, 8, 9	7, 8	7, 8, 9					7
Simplifying Fractions	6, 7, 8	6, 7, 8	6, 7, 8	6, 7, 8	7, 8	8	6, 7, 8			
Renaming Fractions in Higher Terms	6, 7, 8	6, 7, 8	6, 7, 8	6, 7, 8	7, 8	8	6, 7, 8			
Mixed Form	6, 7	6, 7	6, 7	6, 7	6, 7					
Rename Mixed Form as Fractions			6, 7, 8	6, 7, 8	6, 7, 8	8	6, 7, 8			
Rename Fractions as Mixed Form			6, 7, 8	6, 7, 8	6, 7, 8	8	6, 7, 8			
Equivalent Fractions	6, 7	6, 7	6, 7	6, 7		6, 7	6, 7, 8			6, 7
Nonequivalent Fractions		6, 7, 8	6, 7, 8	6, 7, 8	7, 8	8	6, 7, 8		6, 7, 8	

UNIT FRACTIONAL NUMBERS GRADE(S) Six through Nine

Multiplication of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Expressing a Whole Number as a Fraction	6	6	6		6	6	6			
Fraction Times Whole Number, Meaning	6, 7	6, 7	6	7	7					
Fraction Times Whole Number	6	6	6, 7, 8	6, 7, 8	7, 8	8	6, 7, 8, 9			
Fraction Times Fraction, Meaning	6, 7	6, 7	6, 7	7						
Fraction Times Fraction	6	6	6, 7, 8	6, 7, 8	7, 8	8	6, 7, 8, 9			
Mixed Form Times Whole Number	6	6	6, 7, 8	6, 7, 8	7, 8	8	6, 7, 8, 9			
Mixed Form Times Fraction	6	6	6, 7, 8	6, 7, 8	7, 8	8	6, 7, 8, 9			
Mixed Form Times Mixed Form	6	6	6, 7, 8	6, 7, 8	7, 8	8	6, 7, 8, 9			
Closure Property					7	8, 9				
Commutative Property	7	6, 7	7	6, 7, 8, 9		7, 8				
Associative Property	8	8	8	8		8, 9	9			8, 9
Distributive Property	9	9	9			9	9			9
Identity Element	6	6	6	6	6	6	6			
Estimation	6	6	6	6, 7, 8, 9						
Translating Verbal Problems into Number Sentences	6, 7 8, 9	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9			6, 7, 8, 9		

UNIT FRACTIONAL NUMBERS GRADE(S) Six through Nine

Division of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Meaning	6	6	6, 7	6, 7	7					
Reciprocals	7	7	7, 8	8	8		7			
Complex Fractions	7	7	7, 8, 9	7, 8, 9	8, 9	9	7, 8, 9			
Fraction Divided by a Whole Number	7	7	7, 8, 9	7, 8, 9	8, 9	9	7, 8, 9			
Whole Number Divided by a Fraction	7	7	7, 8, 9	7, 8, 9	8, 9		7, 8, 9			
Fraction Divided by a Fraction	7	7	7, 8, 9	7, 8, 9	8, 9	9	7, 8, 9			
Mixed Form Divided by a Whole Number	8	8	8, 9	8, 9	9		8, 9			
Whole Number Divided by a Mixed Form	8	8	8, 9	8, 9	9		8, 9			
Mixed Form Divided by a Fraction	8	8	8, 9	8, 9	9		8, 9			
Fraction Divided by a Mixed Form	8	8	8, 9	8, 9	9		8, 9			
Mixed Form Divided by a Mixed Form	9	9	9	9	9	9	9			
Closure Property					8	8				
Non-Commutativity		7, 8	7, 8	8, 9						
Non-Associativity	9	9	9							
Identity Element	8	8		8						
Inverse Operation	8	8	8	8	9		9			
Translating Verbal Problems into Number Sentences	7, 8, 9	7, 8, 9	7, 8, 9	7, 8, 9	7, 8, 9			7, 8, 9		

UNIT FRACTIONAL NUMBERS GRADE(S) Six through Nine

Addition of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Meaning of Addition of Fractions	6	6	6	6	7					
Addition of Fractions, Like Denominators	6	6	6	6		6	6, 7			
Least Common Multiple	6	6	6, 7, 8, 9	6, 7, 8, 9	7	6, 7, 8, 9	6, 7, 8, 9			6, 7, 8, 9
Addition of Fractions, Unlike Denominators	7, 8	7, 8	7, 8	7, 8, 9			7, 8, 9			
Whole Number Plus Fraction	6	6	6	6	6, 7		6, 7			
Whole Number Plus Mixed Form	6	6	6	6	6, 7		6, 7			
Fraction Plus Mixed Form, Like Denominators	6	6	6	6	6, 7	7	6, 7			
Mixed Form Plus Fraction, Unlike Denominators	7	7	7	7			7			
Mixed Form Plus Mixed Form, Like Denominators	6	6	6, 7	6, 7	6, 7	7	6, 7			
Mixed Form Plus Mixed Form, Unlike Denominators	7	7	7	7	7		7			
Miscellaneous Problems of Adding Fraction Expressions			8	8, 9		9	8, 9			
Closure Property	7	7				6, 7, 8, 9				
Commutative Property	7	6, 7	6, 7	6, 8, 9		7, 8	6, 7, 8			8, 9
Associative Property	8	8	8	8, 9		8	8, 9			8, 9
Identity Element	6	6	6	6	6	6	6			
Estimation	6	6	6	6, 7, 8, 9	6		6, 8, 9			
Translating Verbal Problems into Number Sentences	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9			6, 7, 8, 9		

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UNIT FRACTIONAL NUMBERS GRADE(S) Six through Ten

Subtraction of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Relationship of Addition and Subtraction, Meaning	6	6	6	6	6					
Subtraction, Like Denominators	6	6	6	6	6	7	6, 7			
Subtraction, Unlike Denominators	7	7	7	7, 8	7	8	7, 8			
Fractions from Mixed Form, Like Denom., No Renaming	6	6	6	6, 7	6	7	6, 7			
Fractions from Whole Numbers	6	6	6	6, 7	6	7	6, 7			
Renaming Whole Numbers as Mixed Forms	6	6	6	6	6	7	6, 7			
Fractions from Mixed Forms, Like Denom., Renaming	6	6	6	6, 7, 8	7	8	6, 7, 8			
Fractions from Mixed Forms, Unlike Denom., No Renaming	7	7	7	7	7	8	7, 8			
Fractions from Mixed Forms, Unlike Denom., Renaming	7	7	7	7	7	8	7, 8			7, 8
Whole Number from Mixed Forms	6	6	6	6	6	7	6, 7			
Mixed Forms from Mixed Forms, No Renaming	6	6	6	6, 7	6	7	6, 7			
Mixed Form from Whole Number	6	6	6	6	6	7	6, 7			
Mixed Forms from Mixed Form, Like Denom., Renaming	6	6	6	6, 7, 8	7	8	6, 7, 8			6, 7, 8
Mixed Form from Mixed Form, Unlike Denom., No Renaming	7	7	7	7, 8	7	8	7, 8			
Mixed Form from Mixed Form, Unlike Denom., Renaming	7	7	7	7, 8	7	8	7, 8			7, 8
Closure Property		6	7	6, 7, 8		7, 8				
Non-Commutativity	7	6	7, 8							
Non-Associativity	7	6		6, 7, 8						

UNIT FRACTIONAL NUMBERS GRADE(S) Six through Ten

Subtraction of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Identity Element		6	6		6	6, 7, 8	6			
Inverse Operation	8	8		8	9	10	9			
Translating Verbal Problem to Number Sentences	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9					

UNIT **DECIMAL NUMERALS** GRADE(S) **Six through Ten**

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Place Value	6, 7, 8	6, 7, 8				6, 7, 8				6, 7, 8
Numbers to a Million	6	6	6						6	
Numbers to a Billion	7, 8	7, 8	7, 8						7, 8	
Number Patterns				6, 7, 8		6, 7, 8	6, 7, 8			
Equivalent Powers of Ten						6, 7, 8				
Expanded Notation			6, 7, 8							
Decimal Equivalence	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8						
Annexing Zeros	6, 7, 8, 9	6, 7, 8, 9	6, 7, 8, 9							
Number Line	6, 7	6, 7	6, 7			6, 7			6, 7	
Comparing Numbers			6, 7, 8						6, 7, 8	
Betweenness	6, 7, 8, 9		6, 7, 8, 9							
Rounded Numbers	6, 7, 8, 9	6, 7, 8, 9					6, 7, 8, 9			
Decimal Simplifying Numerals	6, 7, 8	6, 7, 8		6, 7, 8						
Equivalence Decimal Charts			8	8						
Column Form Addition			6, 7, 8, 9	6, 7, 8, 9						
Arrange Addends in Column Form			6, 7, 8, 9			6, 7, 8, 9				
Estimating Sums			8	8	8					
Subtraction			6, 7, 8, 9	6, 7, 8, 9						

UNIT DECIMAL N''JMERALS GRADE(S) Ten

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Division of a Decimal by a Decimal			10	10						
Quotients Rounded			10	10	10					
Decimal Equivalents	10	10	10	10						

UNIT PERCENT BY RATIO AND PROPORTION GRADE(S) Eight through Ten

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Meaning of Ratio	8	8	8	8	8					
Meaning of Rate Pair	8	8	8	8	8					
Simplifying a Rate Pair	8	8	8			8	8			
Translating Verbal Problems into Rate Pairs		8	8	8	8					
Meaning of Percent by Rate Pairs		8	8	8	8					
Changing Percents in Verbal Problems to Rate Pairs		8		8						
Equivalent Rate Pairs						9	9			
Proportion	9	9	9	9						
Solving Multiplication Equation	9	9	9			9	9, 10			
Translating Verbal Problems into Equivalent Rate Pairs		9	9	9	9					
Solving Proportions		9	9			9	9, 10			
Finding What Percent One Number is of Another		9	9				9, 10			
Translating Verbal Problems into Equivalent Rate Pairs		9	9	9	9					
Finding a Percent of a Number		10	10			10	10			10
Finding a Number When a Percent of it is Known		10	10			10	10			10
Translating Verbal Problems into Equal Rate Pairs		10	10	10	10					10

UNIT SQUARE ROOT GRADE(S) Seven through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Square Numbers	7	7	7	7	7					7
Vocabulary	7, 8	7, 8								8
Symbol	8	8		8						8
Expansion of Powers	8	8	8	8	8					8
Use of Square Root Table	9	9	9	9	9					
Extracting Square Roots			10, 11	10, 11	10, 11		10, 11			

UNIT COMPUTING DEVICES GRADE(S) Ten

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Vocabulary	10	10								10
Calculator			10	10	10					
Addition, Subtraction, Multiplication, Division			10	10						
Accuracy			10		10					
Combined Operations			10	10				10		

UNIT **SLIDE RULE** GRADE(S) **Eleven**

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Vocabulary	11	11								11
Construction of Slide Rules			11	11	11					
Reading Scales			11		11					
Multiplication			11	11						
Division			11	11						
Combined Operations			11	11	11			11		
Estimating Solutions			11	11			11			
Square Root			11	11						
Squaring			11	11						

UNIT WHOLE NUMBERS GRADE(S) Seven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Numerals to Billions	7	7	7						7	7
Rounding to Billions	7	7	7				7			7
Expanded Notation to Billions	7	7	7					7		
Place Value to Billions	7	7								
Denominate Numbers						7				
Betweenness			7							
Symbol(s)	7	7		7						
Vertical Form Addition			7	7						
Estimation			7	7	7		7			
Identity						7				
Inverse Operations		7			7					
Vertical Form Subtraction			7	7						
Role of Zero						7				
Vertical Form Multiplication			7	7						
Rules for Divisibility						7	7			
Prime Numbers	7	7	7							7
Composite Numbers	7	7	7		7					
Prime Factorization	7	7	7	7	7					7

UNIT WHOLE NUMBERS GRADE(S) Seven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Multiples	7	7		7	7					
Fower	7	7	7	7	7					
Base	7	7	7		7					
Exponent	7	7	7		7					
Division			7	7						
Role of One						7				
Translating Verbal Problems			7	7				7		

WHOLE NUMBERS - Grade 7

Note: In the following list of objectives, we shall agree to use phrases such as "a three digit number" to mean "a number named by a numeral containing three digit symbols."

Numerals to Billions | Page

The student should be able to:

1. Name and identify numerals to billions
2. Demonstrate writing numerals to billions
3. Order numbers to billions using less than, more than
4. Order numbers to billions using the number line
5. Distinguish between numerals such as 1500 and 15,000, 51 and 15, etc.

Rounding Numbers

The student should be able to:

1. Name and identify numbers rounded to the nearest billion
2. Demonstrate how to write numbers rounded to the nearest billion
3. Apply the principle of rounding to the nearest billion to solve related problems
4. Distinguish between numbers rounded to various accuracies

Expanded Notation

The student should be able to:

1. Name and identify numerals in expanded notation to billions
2. Demonstrate how to expand numerals in expanded notation up to billions using no exponents
3. Apply the principle of writing numerals in expanded notation without exponents to solve related problems

Page

Place Value to Billions

The student should be able to:

1. Name and identify the place value of digits in numerals to billions

Denominate Numbers FO-94

The student should be able to:

1. State the principle that only like denominate numbers may be combined

Betweenness

The student should be able to:

1. Demonstrate how to find or locate a number between two others (up to billions) with and without the number line

ADDITION

Vertical Form Addition FO-78
FO-81
R - 2

The student should be able to:

1. Demonstrate how to add four three digit numbers

2. Construct the sum of four three digit numbers

Estimating Sums

The student should be able to:

1. Describe an estimate as an approximation of an exact sum

2. Demonstrate how to estimate a sum

3. Construct estimates of sums

4. Apply the following principles of estimation:

    a. Round each addend

    b. Construct the sum of the rounded addends

Properties

The student should be able to:

1. State the principle of zero as the additive identity

SU TRACTION

Page

Inverse Operations of Addition and Subtraction

The student should be able to:

1. Identify addition and subtraction as inverse operations

2. Describe how ε idition and subtraction are related as inverse operations

Vertical Form Subtraction

FO-83
R-2

The student should be able to:

1. Demonstrate how to subtract 'hree digit numbers with renaming

2. Construct differences of three digit numbers with renaming

Estimating Differences

The student should be able to:

1. Describe an estimate as an approximation of an exact difference

2. Demonstrate how to estimate a difference

3. Construct estimates of differences

4. Apply the following principles of estimation:

   a. Round the subtrahend and the minuend

   b. Construct the difference of a rounded subtrahend and minuend

Properties

The student should be able to:

1. State the principle that zero is a number that may be subtracted without affecting the minuend

MULTIPLICATION

Symbol

The student should be able to:

1. Name, identify, and draw the symbol "•" for multiplication

Vertical Form Multiplication | Page: FO-85, FO-87, R-2

The student should be able to:

1. Demonstrate how to multiply a two digit number by a three digit number
2. Construct products of a two digit number and a three digit number

Estimating Products

The student should be able to:

1. Describe an estimate as an approximation of an exact product
2. Demonstrate how to estimate a product
3. Construct estimates of products
4. Apply the following principles of estimation:
   a. Round the factors
   b. Construct the product of the rounded factors

Rules for Divisibility

The student should be able to:

1. State the rules for divisibility by three and nine
2. Apply the principles of divisibility by three and nine

Prime Numbers

The student should be able to:

1. Name and identify prime numbers
2. Demonstrate how to determine if a number is prime by expressing it as the product of exactly two factors
3. Distinguish between prime and composite numbers

Page

Composite Numbers

The student should be able to:

1. Name and identify composite numbers
2. Demonstrate how to determine if a number is composite by expressing it as the product of at least three factors
3. Describe a composite number as a number having factors other than itself and one

Prime Factorization

The student should be able to:

1. Name and identify numbers expressed as prime factorization
2. Demonstrate how to express a number as a prime factorization using exponents
3. Construct the prime factorization of a number using exponents
4. Describe a number expressed as a prime factorization
5. Distinguish prime factorizations from other factorizations

Multiples of a Whole Number

The student should be able to:

1. Name and identify multiples of a whole number
2. Construct multiples of any given whole number
3. Construct number patterns using multiples of whole numbers
4. Describe a multiple of a whole number as a number having the given number as a factor

Powers of a Whole Number

The student should be able to:

1. Name and identify powers of a whole number
2. Demonstrate how to express numbers in exponential form, such as $8 = 2^3$

Page

3. Construct expansions of exponential forms, such as $2^3 = 8$

4. Describe a power as the expansion of an exponential form

Bases

The student should be able to:

1. Name and identify bases

2. Demonstrate how to use the base of an exponential form when rewriting in expanded form

3. Describe a base as the number raised to a power in exponential forms

Exponents

The student should be able to:

1. Name and identify exponents

2. Demonstrate how to use the exponents of an exponential form when rewriting in expanded form

3. Describe an exponent as the number which indicates the number of times the base is to be used as a factor

Properties of Zero and One under Multiplication

The student should be able to:

1. State the principle that multiplication by zero always gives zero as a product

2. State the principle of one as the multiplicative identity

DIVISION

Symbol of Division

The student should be able to:

1. Name, identify, and draw the fractional bar to indicate division

Inverse Operations of Multiplication and Division

The student should be able to:

1. Identify multiplication and division as inverse operations

2. Describe multiplication and division as inverse operations

Division

The student should be able to:

1. Demonstrate how to find quotients with remainders where the divisor is a two digit number

2. Demonstrate how to find quotients without remainders where the divisor is a three digit number

3. Construct a quotient with a remainder where the divisor is a two digit number

4. Construct a quotient without a remainder where the divisor is a three digit number

Properties

The student should be able to:

1. State the principle that the number one may be used as a divisor without affecting the dividend

Estimating Quotients

The student should be able to:

1. Describe an estimate as an approximation of the exact quotient

2. Demonstrate how to estimate a quotient

3. Construct an estimate of a quotient

4. Apply the following principles of estimation:

   a. Round the divisor and dividend

   b. Construct the quotient of the rounded divisor and dividend

Pag

FO-
FO-
R-2

Translating Verbal Problems | Page

The student should be able to:

1. Demonstrate converting a verbal problem into a numerical statement | FO-9

2. Construct the solution of a verbal problem

3. Construct original verbal problems

4. Interpret the sequence of steps necessary to translate and solve verbal problems

UNIT FRACTIONAL NUMBERS GRADE(S) Seven

Preliminary Topics

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Meaning of Fractions										
Numerator and Denominator										
Symbols (Fraction Bar)										
Number Line	7	7	7	7						
Comparing Fractions										
Divisibility Rules		7	7			7	7			7
Fractional Names for One							7			
Greatest Common Factor	7	7	7	7	7					7
Simplifying Fractions	7	7	7	7	7		7			
Renaming Fractions in Higher Terms	7	7	7	7	7		7			
Mixed Form	7	7	7	7	7					
Rename Mixed Form as Fractions			7	7	7		7			
Rename Fractions as Mixed Form			7	7	7		7			
Equivalent Fractions	7	7	7	7		7	7			7
Nonequivalent Fractions		7	7	7	7		7		7	

NUMBERS, OPERATIONS AND ALGORITHMS
FRACTIONAL NUMBERS - Grade 7

Preliminary Topics

Page

Number Line

(Use fractions whose denominators are 2, 4, 8, 3, 6, and 10)

The student should be able to:

1. Name and identify fractions by associating them with points on the number line
2. Demonstrate how to find the point on the number line which is associated with a given fraction and vice versa
3. Construct a number line using units of $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{3}, \frac{1}{6}, \frac{1}{10}$

Divisibility Rules

The student should be able to:

1. Identify numbers which are divisible by 3 and 9
2. Demonstrate a procedure for testing whether a number is divisible by 3 and 9
3. State the principles that:
   a. If the sum of the digits is divisible by 3, then the number is divisible by 3
   b. If the sum of the digits is divisible by 9, then the number is divisible by 9
4. Apply the principles of the divisibility rules to solve related problems
5. Distinguish between the divisibility rules for 3 and 9

Fractional Names for One

The student should be able to:

1. Apply the principle of fractional names for one to solve related problems

Page

Greatest Common Factor

(Use multiples of 2, 3, 4, 5, 8, 10 for a different pair of numbers)

The student should be able to:

1. Name and identify the greatest common factor for a pair of numbers
2. Demonstrate how to find the greatest common factor by finding the product of the members in the intersection of the sets of prime factors for each number
3. Construct the greatest common factor for a pair of numbers
4. Describe the intersection procedure for finding the greatest common factor
5. Distinguish among common factors to find the greatest common factor

Simplifying Fractions

(Listed below are some representative examples. Note that both numerator and denominator are divisible by 2, 3, 5, 9, or 10)

$$\frac{2}{4},\ \frac{3}{12},\ \frac{5}{12},\ \frac{9}{18},\ \frac{10}{20},\ \frac{4}{6},\ \frac{9}{12},\ \frac{10}{25},\ \frac{20}{30}$$

The student should be able to:

1. Name and identify fractions which are expressed in simplest terms
2. Demonstrate how to simplify fractions using the divisibility rules
3. Construct equivalence charts showing pairs of simplified fractions
4. Construct the simplest form of a given fraction
5. Describe a procedure for simplifying fractions
6. Apply the principle for simplifying fractions to solve related problems

Renaming Fractions in Higher Terms

(Listed below are some representative examples)

$\frac{1}{2} = \frac{\square}{8}$, $\frac{1}{5} = \frac{\square}{20}$, $\frac{3}{4} = \frac{\square}{24}$, $\frac{1}{16} = \frac{\square}{64}$,

$\frac{1}{3} = \frac{\square}{15}$, $\frac{2}{3} = \frac{\square}{12}$, $\frac{1}{10} = \frac{\square}{70}$, $\frac{5}{12} = \frac{\square}{60}$

The student should be able to:

1. Name and identify fractions in higher terms
2. Demonstrate how to rename fractions by using equivalence charts and by multiplying by a fractional name for one
3. Construct equivalence charts to illustrate the renaming of fractions in higher terms
4. Construct a fraction in higher terms equivalent to a given fraction
5. Describe a procedure for renaming a fraction in higher terms
6. Apply the principle for renaming fractions in higher terms to solve related problems

Mixed Forms

(Use whole numbers less than 100 and fractions whose denominators are 2, 4, 8, 3, 6, 5, and 10)

The student should be able to:

1. Name and identify numbers written in mixed form
2. Demonstrate how to write mixed forms
3. Construct drawings to illustrate fractions written in mixed form
4. Describe a mixed form as a whole number plus a fraction or in terms of concrete objects

Renaming Mixed Forms as Fractions

(Use whole numbers less than 100 and fractions whose denominators are 2, 4, 8, 3, 6, 5, and 10)

Page

The student should be able to:

1. Demonstrate a procedure for renaming a mixed form as a fraction
2. Construct a fraction given a number written in mixed form
3. Describe a procedure for renaming a mixed form as a fraction
4. Apply the principle for renaming a mixed form as a fraction to solve related problems

Renaming Fractions as Mixed Forms

(Listed below are some representative examples)

$$\frac{7}{2}, \frac{36}{5}, \frac{19}{12}, \frac{13}{10}, \frac{32}{15}, \frac{18}{12}$$

The student should be able to:

1. Demonstrate a procedure for renaming a fraction as a mixed form
2. Construct a mixed form given a fraction
3. Describe a procedure for renaming a fraction as a mixed form
4. Apply the principle for renaming a fraction as a mixed form to solve related problems

Equivalent Fractions

(Listed below are some representative examples)

$$\frac{2}{3} = \frac{12}{18}, \frac{2}{5} = \frac{6}{15}, \frac{7}{10} = \frac{28}{40}, \frac{3}{4} = \frac{21}{28}, \frac{7}{8} = \frac{14}{16},$$

$$\frac{5}{16} = \frac{10}{32}$$

The students should be able to:

1. Name and identify sets of equivalent fractions
2. Demonstrate a test for determining whether or not two fractions are equivalent
3. Construct sets of equivalent fractions given any fraction

Page

4. State the principle that pairs of fractions are equivalent if their cross products are equal

5. Apply this principle to find pairs of equivalent fractions

6. Distinguish pairs of equivalent fractions from those pairs which are not equivalent

Nonequivalent Fractions

(Listed [illegible] are some representative examples)

$\frac{3}{4} > \frac{7}{10}$, [illegible] $\frac{3}{4}$, $\frac{7}{8} > \frac{8}{15}$, $\frac{8}{15} < \frac{7}{8}$, $\frac{9}{10} > \frac{12}{15}$, $\frac{12}{15} < \frac{9}{10}$

The student should be able to:

1. Identify pairs of nonequivalent fractions

2. Demonstrate a test to determine whether two fractions are nonequivalent

3. Construct drawings of number lines to illustrate nonequivalent fractions

4. Describe nonequivalent fractions in terms of equivalent fractions or being less than or greater than one another

5. Apply the principle to find pairs of nonequivalent fractions to solve related problems

6. Order nonequivalent fractions

UNIT FRACTIONAL NUMBERS GRADE(S) Seven

Multiplication of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Fraction Times Whole Number, Meaning	7	7		7	7					
Fraction Times Whole Number			7	7	7		7			
Fraction Times Fraction, Meaning	7	7	7	7						
Fraction Times Fraction			7	7	7		7			
Mixed Form Times Whole Number			7	7	7		7			
Mixed Form Times Fraction			7	7	7		7			
Mixed Form Times Mixed Form			7	7	7		7			
Closure Property					7					
Commutative Property	7	7	7	7		7				
Estimation				7						
Translating Verbal Problems into Number Sentences	7	7	7	7	7			7		

NUMBERS, OPERATIONS AND ALGORITHMS
FRACTIONAL NUMBERS - Grade 7

Multiplication of Fractions

The Product of a Fraction and Whole Number - Meaning | Page

The student should be able to:

1. Name and identify whole numbers which are expressed as equivalent fractional numbers with a denominator of one

2. Construct drawings to illustrate the meaning of a fraction times a whole number

3. Describe the meaning of finding the product of a fraction times a whole number, using diagrams and number lines

The Product of a Fraction and Whole Number
(Some representative examples will be found in Chart I)

The student should be able to:

1. Demonstrate how to construct the product of a fraction and a whole number, by using the multiplicative and renaming principles of fractions, and simplifying the final answer

2. Construct the product of a fraction and a whole number

3. Describe how to find the product, in lowest terms, of a fraction and a whole number, using specific examples

4. Apply the following principles for multiplying a fraction and a whole number:

   a. Rename the whole number as a fraction

   b. Multiply the numerators and denominators, expressing the answer in simplest form

Page

CHART I

Fraction x Whole Number - Grade 7

$\frac{1}{3} \times \frac{4}{1}$	$\frac{1}{2} \times \frac{4}{1}$
$\frac{2}{3} \times \frac{4}{1}$	$\frac{3}{4} \times \frac{8}{1}$
$\frac{1}{4} \times \frac{4}{1}$	$\frac{1}{4} \times \frac{2}{1}$
$\frac{3}{4} \times \frac{4}{1}$	$\frac{3}{4} \times \frac{2}{1}$
$\frac{2}{3} \times \frac{14}{1}$	$*\frac{5}{6} \times \frac{9}{1}$
$\frac{3}{14} \times \frac{14}{1}$	$*\frac{5}{9} \times \frac{6}{1}$
$\frac{3}{7} \times \frac{14}{1}$	$*\frac{5}{6} \times \frac{15}{1}$
$\frac{3}{24} \times \frac{12}{1}$	$*\frac{7}{25} \times \frac{15}{1}$

*Students are expected to find the product and simplify the final answer. The "short-cut" method should be used only in examples of the following types:

$$\frac{3}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{4}}}{1}, \quad \frac{1}{\underset{1}{\cancel{2}}} \times \frac{\overset{2}{\cancel{4}}}{1}, \quad \frac{1}{\underset{2}{\cancel{4}}} \times \frac{\overset{1}{\cancel{2}}}{1}$$

The Product of Two Fractions - Meaning

Page

The student should be able to:

1. Name and identify a multiplication problem whose factors are common fractions
2. Demonstrate the meaning of multiplying a fraction times a fraction using the number line and diagrams
3. Construct drawings to illustrate the meaning of a fraction times a fraction

The Product of Two Fractions

(Some representative examples will be found in Chart II)

The student should be able to:

1. Demonstrate how to construct the product of two common fractions using the multiplicative principle of fractions. The final answer should be simplified.
2. Construct the product of two common fractions
3. Describe how to find the product in lowest terms of two common fractions using specific examples
4. Apply the following principle for multiplying two fractions:
   a. Multiply the numerators and multiply the denominators.
   b. Form a new fraction and express it in lowest terms

CHART II

Fraction x Fraction - Grade 7

$\frac{1}{3} \times \frac{1}{2}$	$\frac{4}{5} \times \frac{1}{17}$	$\frac{3}{8} \times \frac{4}{5}$
$\frac{1}{3} \times \frac{4}{5}$	$\frac{1}{3} \times \frac{14}{15}$	$\frac{5}{9} \times \frac{6}{7}$
$\frac{2}{3} \times \frac{4}{5}$	$\frac{12}{13} \times \frac{4}{5}$	$\frac{2}{3} \times \frac{3}{4}$
$\frac{1}{3} \times \frac{3}{5}$	$\frac{1}{4} \times \frac{4}{15}$	$\frac{6}{7} \times \frac{7}{9}$
$\frac{2}{3} \times \frac{3}{5}$	$\frac{8}{13} \times \frac{1}{8}$	$\frac{6}{8} \times \frac{4}{9}$
$\frac{2}{3} \times \frac{1}{2}$	$\frac{1}{8} \times \frac{16}{17}$	$\frac{6}{9} \times \frac{6}{9}$
$\frac{3}{5} \times \frac{2}{3}$	$\frac{3}{8} \times \frac{16}{17}$	$\frac{2}{9} \times \frac{9}{16}$
$\frac{1}{2} \times \frac{4}{5}$	$\frac{5}{6} \times \frac{14}{17}$	[illegible] $\times \frac{9}{21}$
$\frac{2}{3} \times \frac{6}{7}$	$\frac{1}{4} \times \frac{2}{13}$	$\frac{6}{16} \times \frac{8}{9}$
$\frac{5}{6} \times \frac{8}{9}$	$\frac{3}{4} \times \frac{2}{13}$	$\frac{12}{15} \times \frac{6}{9}$
$\frac{1}{4} \times \frac{2}{5}$	$\frac{5}{16} \times \frac{6}{7}$	

Students are expected to find the product and simplify the final answer. The "short-cut" method should be used only in examples of the following types:

$$\frac{3}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{4}}}{1}, \quad \frac{1}{\underset{1}{\cancel{2}}} \times \frac{\overset{2}{\cancel{4}}}{1}, \quad \frac{1}{\underset{2}{\cancel{4}}} \times \frac{\overset{1}{\cancel{2}}}{1}$$

<u>The Product of a Number in Mixed Form and Whole Number</u>

(Some representative examples will be found in Chart III below)

The student should be able to:

1. Demonstrate how to construct the product of a mixed form and a whole number, by using the multiplicative principle and renaming principle of fractions, and simplifying the final answer
2. Construct the product of a mixed form and a whole number
3. Describe how to find the product in lowest terms of a mixed form and a whole number using specific examples
4. Apply the following principles for multiplying a mixed form and a whole number:
   a. Rename the mixed form as an improper fraction
   b. Rename the whole number as a fraction
   c. Multiply the numerators and denominators, expressing the answer in simplest form

CHART III

Mixed Form x Whole Number - Grade 7

$1\frac{2}{3} \times \frac{4}{1}$	$2\frac{3}{5} \times \frac{14}{1}$
$1\frac{3}{4} \times \frac{4}{1}$	$4\frac{1}{4} \times \frac{4}{1}$
$1\frac{1}{4} \times \frac{8}{1}$	$3\frac{3}{4} \times \frac{8}{1}$
$1\frac{1}{4} \times \frac{2}{1}$	$3\frac{3}{4} \times \frac{2}{1}$
* $1\frac{1}{6} \times \frac{9}{1}$	* $2\frac{5}{6} \times \frac{9}{1}$
* $1\frac{1}{6} \times \frac{4}{1}$	* $2\frac{5}{6} \times \frac{4}{1}$

*Students are expected to find the product and simplify the final answer. The "short-cut" method should be

Page

Page

used only in examples of the following types:

$$\frac{3}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{4}}}{1}, \quad \frac{1}{\underset{1}{\cancel{2}}} \times \frac{\overset{2}{\cancel{4}}}{1}, \quad \frac{1}{\underset{2}{\cancel{4}}} \times \frac{\overset{1}{\cancel{2}}}{1}$$

The Product of a Number in Mixed Form and a Fraction

(Some representative examples will be found in Chart IV)

The student should be able to:

1. Demonstrate how to construct the product, in lowest terms, of a mixed form and a fraction, using the multiplicative principle and renaming principle of fractions
2. Construct the product of a mixed form and a fraction
3. Describe how to find the product, in lowest terms, of a mixed form and a fraction, using specific examples
4. Apply the following principles for multiplying a mixed form and a fraction:
    a. Rename the mixed form as an improper fraction
    b. Multiply the numerators and denominators, expressing the answer in simplest form

CHART IV

Mixed Form x Fraction - Grade 7

$2\frac{2}{3} \times \frac{1}{3}$	$3\frac{2}{3} \times \frac{1}{6}$
$1\frac{1}{2} \times \frac{5}{7}$	$3\frac{1}{4} \times \frac{6}{17}$
$1\frac{3}{5} \times \frac{1}{8}$	$5\frac{1}{5} \times \frac{1}{26}$
$1\frac{2}{5} \times \frac{3}{8}$	$3\frac{4}{5} \times \frac{3}{19}$
$1\frac{1}{5} \times \frac{1}{3}$	$3\frac{1}{5} \times \frac{1}{8}$
$1\frac{3}{5} \times \frac{3}{4}$	$4\frac{2}{3} \times \frac{2}{7}$
$1\frac{1}{6} \times \frac{2}{3}$	$1\frac{1}{16} \times \frac{2}{3}$
$1\frac{3}{5} \times \frac{5}{8}$	$2\frac{1}{7} \times \frac{7}{15}$
* $1\frac{1}{2} \times \frac{4}{9}$	* $5\frac{1}{3} \times \frac{9}{32}$
* $1\frac{4}{5} \times \frac{5}{6}$	* $2\frac{4}{7} \times \frac{7}{8}$

*Students are expected to find the product and simplify the final answer. The "short-cut" method should be used only in examples of the following types:

$$\frac{3}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{4}}}{1}, \quad \frac{1}{\underset{1}{\cancel{2}}} \times \frac{\overset{2}{\cancel{4}}}{1}, \quad \frac{1}{\underset{2}{\cancel{4}}} \times \frac{\overset{1}{\cancel{2}}}{1}$$

The Product of Two Numbers in Mixed Form

(Some representative examples will be found in Chart V)

The student should be able to:

1. Demonstrate how to construct the product, in lowest terms, of two mixed forms by using the multiplicative principle and renaming principles of fractions

Page

2. Construct the product of two mixed forms

3. Describe how to find the product, in lowest terms, of two mixed forms using specific examples

4. Apply the following principles for multiplying two mixed forms

   a. Rename the mixed forms as improper fractions

   b. Multiply the numerators and denominators, expressing the answer in simplest form

CHART V

Mixed Form x Mixed Form - Grade 7

$1\frac{1}{2} \times 1\frac{1}{2}$

$1\frac{1}{2} \times 1\frac{2}{3}$

$1\frac{1}{2} \times 1\frac{1}{6}$

$1\frac{1}{3} \times 3\frac{1}{2}$

$1\frac{1}{5} \times 1\frac{3}{4}$

$1\frac{1}{2} \times 1\frac{1}{3}$

$1\frac{1}{6} \times 1\frac{1}{7}$

$2\frac{1}{4} \times 2\frac{2}{3}$

$* \; 2\frac{1}{4} \times 1\frac{2}{6}$

$* \; 1\frac{5}{6} \times 1\frac{3}{6}$

$1\frac{1}{2} \times 1\frac{3}{10}$

$1\frac{1}{2} \times 5\frac{2}{3}$

$1\frac{1}{2} \times 1\frac{1}{15}$

$1\frac{1}{5} \times 1\frac{1}{16}$

$6\frac{2}{3} \times 1\frac{4}{5}$

$1\frac{3}{15} \times 1\frac{3}{4}$

$1\frac{1}{2} \times 5\frac{1}{3}$

$1\frac{3}{4} \times 2\frac{4}{7}$

$2\frac{1}{4} \times 5\frac{1}{3}$

$* \; 3\frac{3}{4} \times 1\frac{2}{6}$

$* \; 1\frac{1}{8} \times 1\frac{2}{12}$

*Students are expected to find the product and simplify the final answer. The "short-cut" method should be used only in examples of the following types:

$$\frac{3}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{4}}}{1}, \quad \frac{1}{\underset{1}{\cancel{2}}} \times \frac{\overset{2}{\cancel{4}}}{1}, \quad \frac{1}{\underset{2}{\cancel{4}}} \times \frac{\overset{1}{\cancel{2}}}{1}$$

Closure Property

The student should be able to:

1. Describe the closure property of the sets of fractions under multiplication

Commutative Property of Multiplication of Fractions
(Use examples found in Chart I through Chart V)

The student should be able to:

1. Name and identify number sentences which illustrate the commutative property of multiplication of fractions
2. Demonstrate a procedure which tests number sentences for commutativity
3. Construct a number sentence to illustrate the commutative property of multiplication of fractions
4. State the commutative property of multiplication of fractions

Estimation

The student should be able to:

1. Construct an estimate of the product of two fractions

Translating Verbal Problems into Number Sentences
(Choose only those problems whose solution can be determined in one step)

The student should be able to:

1. Name and identify verbal problems whose solutions require multiplication of fractions

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2. Demonstrate a procedure for translating verbal problems into number sentences

3. Construct a number sentence from the information contained in a verbal problem

4. Describe the steps needed to translate verbal problems into number sentences using specific examples

5. Interpret the information contained in a verbal problem in order to construct a corresponding number sentence

UNIT FRACTIONAL NUMBERS GRADE(S) Seven

Division of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Meaning			7	7	7					
Reciprocals	7	7	7				7			
Complex Fractions	7	7	7	7			7			
Fraction divided by a Whole Number	7	7	7	7			7			
Whole Number divided by a Fraction	7	7	7	7			7			
Fraction divided by a Fraction	7	7	7	7			7			
Non-Commutativity		7	7							
Translating Verbal Problems into Number Sentences	7	7	7	7	7			7		

Division of Fractions

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Meaning of Division of Fractions
(Listed below are some representative examples)

$6 \div \frac{1}{2}$, $5 \div \frac{1}{3}$, $10 \div \frac{1}{4}$, $\frac{1}{5} \div 2$,

$\frac{1}{8} \div 2$, $\frac{1}{3} \div 4$

The student should be able to:

1. Demonstrate the meaning of division of whole numbers and fractions by using a number line and other concrete objects
2. Construct drawings to illustrate the meaning of division of whole numbers and fractions
3. Describe the meaning of division of whole numbers and fractions by using number lines

Reciprocals
(Listed below are some representative examples)

4, 6, 10, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{2}{3}$

The student should be able to:

1. Name and identify the reciprocals of whole numbers (except 0) and fractions
2. Demonstrate how to write the reciprocal of a whole number and a fraction
3. Apply the principle for constructing the reciprocal of a whole number and of a fraction

Complex Fractions
(Listed below are some representative examples)

$\frac{\frac{1}{2}}{4}$, $\frac{6}{\frac{1}{2}}$, $\frac{\frac{1}{2}}{\frac{1}{2}}$

The student should be able to:

1. Name and identify complex fractions

Page

2. Demonstrate how to write a complex fraction given a division problem of the form $\frac{1}{2} \div 4$, etc.

3. Construct complex fractions given a division problem of the form $\frac{1}{2} \div 4$, etc.

4. Apply the principle of renaming a division example as a complex fraction

Fraction Divided by a Whole Number

(Some representative examples will be found in Chart I below)

The student should be able to:

1. Name and identify a division problem whose parts are a fraction and a whole number

2. Demonstrate how to construct the quotient of a fraction and a whole number by using complex fractions

3. Construct the quotient of a fraction and a whole number

4. Apply the following principles for dividing a fraction by a whole number:

   a. Rename the division problem as a multiplication problem

   b. Multiply the fractions, expressing the answer in simplest form

CHART I

Fraction Divided by a Whole Number - Grade 7

$\frac{1}{2} \div 8$	$\frac{2}{3} \div 4$
$\frac{3}{5} \div 8$	$\frac{9}{10} \div 6$
$\frac{7}{8} \div 7$	$\frac{6}{10} \div 9$
$\frac{4}{5} \div 2$	

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Whole Number Divided by a Fraction

(Some representative examples will be found in Chart II below)

The student should be able to:

1. Name and identify a division problem whose parts are a whole number and a fraction
2. Demonstrate how to construct the quotient of a whole number and a fraction by using complex fractions
3. Construct the quotient of a whole number and a fraction
4. Apply the following principles for dividing a whole number by a fraction:
   a. Rename the division problem as a multiplication problem
   b. Multiply the fractions, expressing the answer in simplest form

CHART II

Whole Number Divided by a Fraction - Grade 7

$6 \div \frac{1}{3}$	$2 \div \frac{4}{5}$
$7 \div \frac{2}{3}$	$2 \div \frac{4}{6}$
$4 \div \frac{4}{5}$	$6 \div \frac{9}{10}$
$8 \div \frac{4}{5}$	$9 \div \frac{6}{11}$

Fraction Divided by a Fraction

(Some representative examples will be found in Chart III)

The student should be able to:

1. Name and identify a division problem whose parts are fractions
2. Demonstrate how to construct the quotient of fractions by using complex fractions

Page

3. Construct the quotient for pairs of fractions
4. Apply the following principles for dividing pairs of fractions:
   a. Rename the division problem as a multiplication problem
   b. Multiply the fractions, expressing the answer in simplest form

CHART III

Fraction Divided by a Fraction - Grade 7

$\frac{1}{4} \div \frac{1}{3}$	$\frac{5}{8} \div \frac{5}{8}$	$\frac{2}{5} \div \frac{3}{10}$
$\frac{3}{4} \div \frac{1}{3}$	$\frac{4}{5} \div \frac{4}{7}$	$\frac{3}{4} \div \frac{1}{2}$
$\frac{3}{4} \div \frac{2}{3}$	$\frac{5}{6} \div \frac{5}{12}$	$\frac{2}{3} \div \frac{4}{9}$
$\frac{1}{4} \div \frac{3}{4}$	$\frac{4}{7} \div \frac{2}{7}$	$\frac{6}{8} \div \frac{9}{12}$

Non-Commutativity

(Use examples found in Chart I through Chart III)

The student should be able to:

1. Identify number sentences which illustrate non-commutativity of division of fractions
2. Demonstrate a procedure which shows that division of fractions is not commutative

Translating Verbal Problems into Number Sentences

(Choose only those problems whose solution can be determined in one step)

The student should be able to:

1. Name and identify verbal problems whose solutions require division of fractions
2. Demonstrate a procedure for translating verbal problems into number sentences

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3. Construct a number sentence from the information contained in a verbal problem

4. Describe the steps needed to translate verbal problems to number sentences, using specific examples

5. Interpret the information contained in a verbal problem in order to construct a corresponding number sentence

UNIT FRACTIONAL NUMBERS GRADE(S) Seven

Addition of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Meaning of Addition of Fractions					7					
Addition of Fractions, Like Denominators							7			
Least Common Multiple			7	7	7	7	7			7
Addition of Fractions, Unlike Denominators	7	7	7	7			7			
Whole Number plus Fraction					7		7			
Whole Number plus Mixed Form					7		7			
Fraction plus Mixed Form, Like Denominators					7	7	7			
Mixed Form plus Fractions, Unlike Denominators	7	7	7	7			7			
Mixed Form plus Mixed Form, Like Denominators			7	7	7	7	7			
Mixed Form plus Mixed Form, Unlike Denominators	7	7	7	7	7		7			
Closure Property	7	7				7				
Commutative Property	7	7	7			7	7			
Estimation				7						
Translating Verbal Problems into Number Sentences	7	7	7	7	7			7		

Addition of Fractions

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Addition of Fractions - Meaning	
The student should be able to:	
1. Describe how to find the sum of fractions with like denominators	
2. Apply the principle of adding fractions with like denominators to solve related problems	
Least Common Multiple (Listed below are some representative examples. Note that the least common multiple as printed here deals with pairs of numbers each of which is less than or equal to 100.)	
(6, 8) (9, 15) (20, 50) (85, 75)	
The student should be able to:	FO-93
1. Name and identify the least common multiple of a pair of numbers	
2. Demonstrate how to find the least common multiple of a pair of numbers	
3. Construct the least common multiple of a pair of numbers	
4. Describe a method for finding the least common multiple (either by the intersection of sets method or by the prime factorization method)	
5. State the principle that the least common multiple is the smallest number divisible by both numbers of the pair	
6. Apply this principle to find the least common multiple and to solve related problems	
7. Distinguish the least common multiple from among other multiples of a pair of numbers	

Addition of Fractions with Unlike Denominators

(Listed below are some representative examples. Note that the denominators are 2, 3, 4, 6, 8, 5, 10. The answers should be simplified.)

$$\begin{array}{r} \frac{1}{3} \\ +\frac{1}{2} \\ \hline \end{array} \qquad \begin{array}{r} \frac{5}{6} \\ +\frac{1}{2} \\ \hline \end{array} \qquad \begin{array}{r} \frac{5}{8} \\ +\frac{1}{4} \\ \hline \end{array} \qquad \frac{2}{3} + \frac{1}{6}, \quad \frac{5}{6} + \frac{1}{8}$$

The student should be able to:

1. Name and identify addition problems where the addends are fractions with unlike denominators
2. Demonstrate a procedure for adding fractions with unlike denominators
3. Construct sums for fraction addends with unlike denominators and express the sum in simplest terms
4. Describe a procedure for adding fractions with unlike denominators
5. Apply the principle for adding fractions with unlike denominators to solve related problems

The Sum of a Whole Number and a Fraction

The student should be able to:

1. Describe how to add a whole number and a fraction using specific examples
2. Apply the principle for adding fractions which have as addends a fraction and a whole number to solve related problems

The Sum of a Whole Number and a Mixed Form

The student should be able to:

1. Describe how to add a whole number and mixed form using specific examples
2. Apply the principle for adding fractions which have as addends a whole number and a mixed form to solve related problems

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<u>The Sum of a Fraction and a Mixed Form with Like Denominators</u>

The student should be able to:

1. Describe how to add a fraction and a mixed form with like denominators using specific problems
2. State the principle that in order to add a fraction and a mixed form with like denominators, first add the fractions as before and then add the whole number to this sum
3. Apply the principle for adding a fraction and a mixed form with like denominators to solve related problems

<u>The Sum of a Mixed Form and a Fraction with Unlike Denominators</u>

(Listed below are some representative examples.
Note the denominators are 2, 3, 4, 6, 8, 5, and 10.
The answers should be simplified.)

$$\begin{array}{r} 18\frac{1}{2} \\ +\ \frac{1}{3} \\ \hline \end{array} \qquad \begin{array}{r} \frac{1}{6} \\ +\ 5\frac{1}{3} \\ \hline \end{array} \qquad \begin{array}{r} 11\frac{2}{5} \\ +\ \frac{9}{10} \\ \hline \end{array} \qquad \begin{array}{r} 8\frac{3}{8} \\ +\ \frac{5}{6} \\ \hline \end{array} \qquad \begin{array}{r} \frac{7}{8} \\ +\ 11\frac{1}{10} \\ \hline \end{array} \qquad 99\frac{1}{3} + \frac{7}{8}$$

The student should be able to:

1. Name and identify an addition problem which has addends of a fraction and a mixed form with unlike denominators
2. Demonstrate a procedure for finding the sum of a mixed form and a fraction with unlike denominators
3. Construct the sum, in simplest terms, for a mixed form and a fraction with unlike denominators
4. Apply the principle that in order to add a mixed form and a fraction with unlike denominators, first add the fractions by expressing them with equal denominators, and then to this sum add the whole number to solve related problems

The Sum of Numbers in Mixed Form, With Like Denominators

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(Listed below are some representative examples. Note that the whole numbers are less than 100 and the denominators are 2, 3, 4, 6, 8, 5, and 10. The answers should be expressed in simplest terms.)

$$\begin{array}{r} 1\frac{1}{4} \\ 2\frac{1}{4} \\ +\ 3\frac{1}{4} \\ \hline \end{array} \qquad \begin{array}{r} 5\frac{1}{3} \\ 1\frac{1}{3} \\ +\ 2\frac{1}{3} \\ \hline \end{array} \qquad \begin{array}{r} 16\frac{5}{6} \\ 7\frac{1}{6} \\ +\ 8\frac{5}{6} \\ \hline \end{array} \qquad \begin{array}{r} 92\frac{1}{8} \\ 17\frac{1}{8} \\ +\ 34\frac{7}{8} \\ \hline \end{array} \qquad 15\frac{1}{2} + 3\frac{1}{2} + 48\frac{1}{2}$$

The student should be able to:

1. Demonstrate a procedure for adding numbers in mixed form with like denominators
2. Construct sums, in lowest terms, of numbers in mixed form with like denominators
3. Describe how to add mixed forms with like denominators using specific examples
4. State the principle that in order to add mixed forms with like denominators, first add the fractions and then to this add the sum of the whole numbers
5. Apply this principle for adding mixed forms with like denominators to solve related problems

The Sum of Numbers in Mixed Form with Unlike Denominators

(Listed below are some representative examples. Note that the whole numbers and the denominators are less than 100, and the denominators are 2, 3, 4, 6, 8, 5, and 10. The answers to these examples should be given in simplest terms.)

$$\begin{array}{r} 10\frac{1}{6} \\ +\ 10\frac{2}{3} \\ \hline \end{array} \qquad \begin{array}{r} 26\frac{1}{4} \\ +\ 35\frac{1}{2} \\ \hline \end{array} \qquad \begin{array}{r} 17\frac{2}{3} \\ +\ 11\frac{5}{6} \\ \hline \end{array} \qquad \begin{array}{r} 38\frac{7}{8} \\ +\ 11\frac{2}{3} \\ \hline \end{array} \qquad 99\frac{1}{5} + 52\frac{3}{8}$$

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The student should be able to:

1. Name and identify addition problems with addends of mixed forms with unlike denominators
2. Demonstrate a procedure for adding numbers in mixed form with unlike denominators
3. Construct a sum, in lowest terms, for addends of mixed forms with unlike denominators
4. Describe a procedure for adding fractions having addends of mixed forms with unlike denominators using specific examples
5. Apply the principle for finding the sum of numbers in mixed form with unlike denominators to solve related problems

Closure Property of Fractions under Addition

The student should be able to:

1. Name and identify closure of fractions under addition
2. State the principle that the set of fractions is closed under addition

Commutative Property of Addition of Fractions

The student should be able to:

1. Name and identify sentences which show the commutative property for addition of fractions
2. Demonstrate how to use the commutative property in adding fractions
3. State the principle that the commutative property means that changing the order of fractional addends does not change the answer

Estimation

The student should be able to:

1. Construct an estimate of the sum of fractional expressions

Translating Verbal Problems into Number Sentences

Page

(Choose only those problems which require one step for solving)

The student should be able to:

1. Name and identify verbal problems containing fractional addends
2. Demonstrate a procedure for translating verbal problems to number sentences
3. Construct a number sentence from the information contained in a verbal problem
4. Describe how a verbal problem is translated into a number sentence
5. Interpret the information in a verbal problem in order to obtain a correct translation into a number sentence

UNIT FRACTIONAL NUMBERS GRADE(S) Seven

Subtraction of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Subtraction, Like Denominators						7	7			
Subtraction, Unlike Denominators	7	7	7	7	7		7			
Fractions from Mixed Forms, Like Denom., No Renaming				7		7	7			
Fractions from Whole Numbers				7		7	7			
Renaming Whole Numbers as Mixed Forms						7	7			
Fractions from Mixed Forms, Like Denom., Renaming				7	7		7			
Fractions from Mixed Forms, Unlike Denom., No Renaming	7	7	7	7	7		7			
Fractions from Mixed Forms, Unlike Denom., Renaming	7	7	7	7	7		7			7
Whole Number from Mixed Forms						7	7			
Mixed Forms from Mixed Forms, No Renaming				7		7	7			
Mixed Form from Whole Number						7	7			
Mixed Forms from Mixed Form, Like Denom., Renaming				7	7		7			7
Mixed Form from Mixed Form, Unlike Denom., No Renaming	7	7	7	7	7		7			
Mixed Form from Mixed Form, Unlike Denom., Renaming	7	7	7	7	7		7			7
Closure Property			7	7		7				
Non-Commutativity	7			7						
Non-Associativity	7			7						
Identity Element						7				

UNIT FRACTIONAL NUMBERS GRADE(S) Seven

Subtraction of Fractions

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Translating Verbal Problems to Number Sentences	7	7	7	7	7					

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Subtraction of Fractions

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Subtraction of Fractions With Like Denominators

(Listed below are some representative examples. Note the denominators are 2, 3, 4, 5, 6, 8, and 10. The answer should be in simplified terms.)

$$\frac{3}{5} - \frac{2}{5} \qquad \frac{1}{6} - \frac{0}{6} \qquad \frac{7}{10} - \frac{3}{10} \qquad \frac{2}{3} - \frac{1}{3}$$

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The student should be able to:

1. State the principle for subtracting fractions with like terms
2. Apply the principle for subtracting fractions to construct the difference of two fractions with like denominators and express the answer in simplified terms

Subtracting Fractions With Unlike Denominators

(Listed below are some representative examples. Note that the denominators are 2, 3, 4, 5, 6, 8, and 10. The answers should be in simplified terms.)

$$\frac{1}{2} - \frac{1}{4} \qquad \frac{5}{8} - \frac{1}{4} \qquad \frac{7}{10} - \frac{2}{5} \qquad \frac{3}{4} - \frac{1}{3} \qquad \frac{7}{8} - \frac{1}{2}$$

The student should be able to:

1. Name and identify problems in which a fraction is subtracted from a fraction with unlike denominators
2. Demonstrate a method for subtracting fractions with unlike terms
3. Construct the difference, in lowest terms, of two fractions with unlike denominators

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4. Describe how to subtract fractions with unlike denominators using specific examples

5. Apply the principle for subtracting fractions with unlike denominators to solve related problems

Subtracting a Fraction From a Mixed Form With Like Denominators - No Renaming

(Listed below are some representative examples.
Note that the denominators are 2, 3, 4, 5, 6, 8, and 10.
The answers should be expressed in simplified terms.

$$8\frac{2}{3} \qquad 16\frac{7}{8} \qquad 25\frac{4}{5} \qquad 28\frac{7}{10}$$

$$-\frac{1}{3} \qquad -\frac{1}{8} \qquad -\frac{3}{5} \qquad -\frac{7}{10}$$

The student should be able to:

1. Construct the difference, in simplified terms, of a fraction and a mixed form with like denominators where no renaming is required

2. State the principles for subtracting a fraction from a mixed form with like denominators

3. Apply the principles for subtracting a fraction from a mixed form with like denominators to solve related problems

Renaming Whole Numbers As Mixed Forms

The student should be able to:

1. State the following principles for changing whole numbers to mixed forms:

   a. Decompose the whole number to one less than itself plus one

   b. Rewrite the one as an equivalent fraction with equal numerator and denominator

2. Apply these principles for changing whole numbers to mixed forms to solve related problems

Subtracting a Fraction From a Whole Number

(Listed below are some representative examples. Note that the denominators are 2, 3, 4, 5, 6, 8, and 10. The answer should be in simplified terms.)

$$\begin{array}{r} 18 \\ -\ \frac{7}{10} \\ \hline \end{array} \qquad \begin{array}{r} 32 \\ -\ \frac{3}{8} \\ \hline \end{array} \qquad \begin{array}{r} 60 \\ -\ \frac{4}{5} \\ \hline \end{array} \qquad 79 - \frac{5}{6}$$

The student should be able to:

1. Construct the difference, in lowest terms, of a fraction and a whole number
2. State the following principles for subtracting a whole number from a fraction:
   a. Rename the whole number as a mixed form with like denominators
   b. Subtract the fraction from the mixed form
3. Apply these principles for subtracting a fraction from a whole number to solve related problems

Subtracting a Fraction From a Mixed Form With Like Denominators When Renaming Is Required

(Listed below are some representative examples. Note that the denominators are 2, 3, 4, 5, 6, 8, and 10. The answers should be expressed in simplified terms.)

$$\begin{array}{r} 2\frac{1}{3} \\ -\ \frac{2}{3} \\ \hline \end{array} \qquad \begin{array}{r} 8\frac{3}{5} \\ -\ \frac{4}{5} \\ \hline \end{array} \qquad \begin{array}{r} 78\frac{5}{8} \\ -\ \frac{7}{8} \\ \hline \end{array} \qquad 19\frac{1}{6} - \frac{5}{6}$$

The student should be able to:

1. Construct the difference, in lowest terms, of a fraction and a mixed form with like denominators when renaming is required.
2. Describe how to subtract a fraction from a mixed form with like terms when renaming is required

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3. Apply the following principles for subtracting a fraction from a mixed form with like denominators when renaming is required:

   a. Rename the fractional part of the mixed form so that it is larger than the fraction

   b. Subtract the fraction from the mixed form

4. Distinguish between problems which require renaming and those which require no renaming

Subtracting a Fraction From a Mixed Form With Unlike Denominators - No Renaming

(Listed below are some representative examples. Note that the denominators are 2, 3, 4, 5, 6, 8, and 10. The answers should be expressed in simplified terms.)

$$4\frac{3}{4} - 2\frac{1}{2} \qquad 6\frac{7}{10} - 1\frac{2}{5} \qquad 5\frac{2}{3} - 3\frac{1}{8} \qquad 9\frac{7}{10} - 7\frac{1}{6}$$

The student should be able to:

1. Name and identify problems in which a fraction is subtracted from a mixed form with unlike denominators

2. Demonstrate a procedure for subtracting a fraction from a mixed form with unlike denominators

3. Construct the difference, in lowest terms, of a fraction and a mixed form with unlike denominators when no renaming is required

4. Describe how to subtract a fraction from a mixed form with unlike denominators when no renaming is required using specific examples

5. Apply the following principles for subtracting a fraction from a mixed form with unlike denominators when no renaming is required:

   a. Rename the mixed form so that the fractional part is larger than the fraction

   b. Subtract the fraction from the mixed form

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Subtracting a Fraction From a Mixed Form With Unlike Denominators - When Renaming Is Required

(Listed below are some representative examples. Note that the denominators are 2, 3, 4, 5, 6, 8, and 10. The answers should be in simplified terms.)

$$7\frac{1}{2} - \frac{3}{4} \qquad 14\frac{1}{10} - 2\frac{1}{5} \qquad 18\frac{3}{4} - \frac{7}{8} \qquad 22\frac{3}{4} - \frac{5}{6} \qquad 37\frac{1}{5} - \frac{5}{6}$$

$$20\frac{3}{5} - 18\frac{7}{10}$$

$$39\frac{1}{6} - 29\frac{5}{8}$$

The student should be able to:

1. Name and identify problems in which a fraction is subtracted from a mixed form with unlike denominators and renaming is required
2. Demonstrate a procedure for subtracting a fraction from a mixed form with unlike denominators and renaming is required
3. Construct the difference in simplified terms, of a fraction and a mixed form with unlike denominators with renaming required
4. Describe, using specific examples, how to subtract a fraction from a mixed number with unlike denominators and renaming is required
5. Apply the following principles for subtracting fractions from mixed forms with unlike denominators and renaming is required:
   a. Rename the minuend so that the fractional part has a like denominator and is larger than the subtrahend
   b. Subtract the fraction from the mixed form with like denominators

Subtracting a Whole Number From a Mixed Form

The student should be able to:

1. State the following principles for subtracting a whole number from a mixed form
   a. Subtract zero from the fraction
   b. Subtract the whole numbers

Page

2. Apply these principles for subtracting a whole number from a mixed form to solve related problems

Subtracting a Mixed Form From a Mixed Form With Like Denominators - Without Renaming

(Listed below are some representative examples. Note that the denominators are 2, 3, 4, 5, 6, 8, and 10. The answer should be in simplified form.)

$$8\frac{3}{4} - 2\frac{1}{4} \qquad 19\frac{5}{6} - 2\frac{1}{6} \qquad 24\frac{7}{10} - 5\frac{4}{10} \qquad 32\frac{5}{8} - 12\frac{5}{8} \qquad 71\frac{3}{5} - 10\frac{2}{5}$$

The student should be able to:

1. Construct the difference, in lowest terms, of two mixed forms with like denominators
2. State the principle for subtracting mixed forms with like denominators:
   a. Subtract fractional parts
   b. Subtract whole numbers
3. Apply the principles for subtracting mixed forms with like denominators to solve related problems

Subtracting a Mixed Form From a Mixed Form With Like Denominators and With Renaming

(Listed below are some representative examples. Note that the denominators are 2, 3, 4, 5, 6, 8, and 10. The answers should be in lowest terms.)

$$8\frac{1}{4} - 6\frac{3}{4} \qquad 11\frac{1}{6} - 10\frac{5}{6} \qquad 20\frac{7}{10} - 7\frac{9}{10} \qquad 40\frac{1}{3} - 19\frac{2}{3}$$

The student should be able to:

1. Construct the difference, in lowest terms, of mixed forms with like denominators requiring renaming
2. Describe, using specific examples, how to subtract mixed forms with like denominators with renaming

Page

3. Apply the following principles for subtracting mixed forms with like denominators requiring renaming:

   a. Rename the minuend so that the fractional part is larger than the fractional part of the subtrahend

   b. Subtract the mixed forms

4. Distinguish between problems which require renaming and those which do not

Subtracting a Mixed Form From a Mixed Form With Unlike Denominators Without Renaming

(Listed below are some representative examples. Note that the denominators are 2, 3, 4, 5, 6, 8, and 10. The answers should be in lowest terms.)

$$\begin{array}{r} 15\frac{1}{2} \\ -\ 8\frac{1}{3} \\ \hline \end{array} \qquad \begin{array}{r} 14\frac{3}{4} \\ -\ 9\frac{3}{8} \\ \hline \end{array} \qquad \begin{array}{r} 27\frac{7}{8} \\ -\ 16\frac{3}{5} \\ \hline \end{array} \qquad 75\frac{9}{10} - 46\frac{1}{4}$$

The student should be able to:

1. Name and identify problems in which mixed numbers with unlike denominators are subtracted

2. Demonstrate a procedure for subtracting mixed forms with unlike denominators when renaming is not required

3. Construct the difference, in simplified terms, of mixed forms with unlike denominators, no renaming required

4. Describe, using specific examples, how to subtract mixed forms with unlike denominators, no renaming required

5. Apply the following principles for subtracting mixed forms with unlike denominators, no renaming required to solve related problems:

   a. Rename the fractional parts so that the denominators are equal

   b. Subtract the mixed forms

Subtracting a Mixed Form From a Mixed Form With Unlike Denominators and With Renaming

Page

(Listed below are some examples. Note that the denominators are 2, 3, 4, 5, 6, 8, and 10. The answers should be simplified.)

$$8\frac{1}{3} - 2\frac{5}{6} \qquad 17\frac{1}{10} - 9\frac{3}{4} \qquad 26\frac{1}{5} - 17\frac{1}{3} \qquad 29\frac{3}{8} - 19\frac{4}{5}$$

The student should be able to:

1. Name and identify problems in which mixed forms with unlike denominators are subtracted
2. Demonstrate a procedure for subtracting mixed forms with unlike denominators requiring renaming
3. Construct the difference, in lowest terms, of mixed forms with unlike denominators requiring renaming
4. Describe, using specific examples, how to subtract mixed forms with unlike denominators requiring renaming
5. Apply the following principles for subtracting mixed forms with unlike denominators requiring renaming:
   a. Rename the fractional parts so that the denominators are equal
   b. Rename the minuend so that the fractional part is larger than the fractional part of the denominator
   c. Subtract the mixed form
6. Distinguish between problems which require renaming and those which do not

Non-Closure

The student should be able to:

1. State the principle that the set of fractions is not closed under subtraction

Page

2. Demonstrate by writing a number sentence that the set of fractions is not closed under subtraction

3. Construct an example showing the set of fractions as not being closed under subtraction

Non-Commutative Property of Subtraction

The student should be able to:

1. Name the operation of subtraction, using fractions, as non-commutative

2. Construct an example showing the set of fractions as non-commutative under the operation of subtraction

Non-Associative Property of Subtraction

The student should be able to:

1. Name the operation of subtraction, using fractions, as non-associative

2. Construct an example showing the set of fractions as being non-associative under the operation of subtraction

Translating Verbal Problems Into Number Sentences
(Choose only those problems where solution can be determined in one step)

The student should be able to:

1. Name and identify verbal problems which contain subtractions of fractions

2. Demonstrate a procedure for writing a number sentence from the information contained in the verbal problem

3. Construct a number sentence from the information contained in the verbal problem

4. Describe, using specific examples, how a verbal problem is translated into a number sentence

UNIT DECIMAL NUMERALS GRADE(S) Seven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Place Value	7	7				7				7
Numbers to a Billion	7	7	7						7	
Number Patterns				7		7	7			
Equivalent Powers of Ten						7				
Expanded Notation			7							
Decimal Equivalence	7	7	7	7						
Annexing Zeros	7	7	7							
Number Line	7	7	7			7			7	
Comparing Numbers			7						7	
Betweenness	7		7							
Rounded Numbers	7	7					7			
Decimal Simplifying Numerals	7	7		7						
Column Form Addition			7	7						
Arrange Addends in Column Form			7			7				
Subtraction			7	7						
Arrange a Subtraction Problem in Vertical Form			7			7				
Multiplication by Powers of Ten			7			7	7			
Products of Decimal and Whole Numbers			7	7						

UNIT **DECIMAL NUMERALS** GRADE(S) **Seven**

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Products of Two Decimals			7	7						
Division of a Decimal by a Whole Number			7	7						
Division of a Whole Number by a Decimal Fraction			7	7						
Division of a Decimal by a Decimal			7	7						
Decimal Equivalents	7	7	7	7						

Page

Place Value for Numbers Between Billions and Ten-Thousandths

The student should be able to:

1. Name and identify the place value and face value for any digit in a given numeral
2. State the principle that in a two digit number written in decimal form:
   a. The place value of a digit is ten times the place value of the digit immediately to its right
   b. The place value of a digit is one-tenth the place value of the digit immediately to its left
3. Distinguish between the place value and the face value of a digit in a numeral

Numbers Between Billions and Ten-Thousandths

The student should be able to:

1. Name and identify any numeral
2. Demonstrate how to write any numeral
3. Order numbers by telling if one is greater than or less than another

Number Patterns Using Hundredths

The student should be able to:

1. State the rule necessary to complete a given pattern
2. Apply the rule to construct the next three numbers in the pattern
3. Construct their own number pattern either written or orally

Equivalent Powers of Ten

The student should be able to:

1. State the principle: $\frac{1}{1,000} = .001$ and $\frac{1}{10,000} = .0001$

Expanded Notation

Page

The student should be able to:

1. Demonstrate how to write expanded notation to give the value of each numeral for any number between millions and ten-thousandths, e.g. $367.0736 = 3 \times 100 + 6 \times 10 + 7 \times 1 + 0 \times .1 + 7 \times .01 + 3 \times .001 + 6 \times .0001$

Decimal Equivalence

The student should be able to:

1. Name and identify the decimal equivalent of a fraction with denominator of 100
2. Name and identify a fractional equivalent with denominator of 100 given a decimal to hundredths place
3. Construct the decimal equivalent of a fraction with a denominator of 100
4. Construct a fractional equivalent with denominator of 100 given a decimal to hundredths place
5. Name and identify the decimal equivalent for any fraction of the form $\frac{\text{whole number}}{4}$ or $\frac{\text{whole number}}{5}$
6. Demonstrate how to use the multiplicative identity to construct decimal names for a given fractional numeral: e.g. $\frac{1}{4} \cdot \frac{25}{25} = .25$

Annexing Zeros

The student should be able to:

1. Name and identify decimals having zeros annexed which are the same as a given decimal
2. Demonstrate how to rename decimal numerals by annexing zeros

Number Line

The student should be able to:

1. Name and identify hundredths on a number line
2. Demonstrate how to construct a number line calibrated to hundredths

Page

3. State the principle that larger numbers are located to the right of a given number and smaller numbers are located to the left

4. Order numbers using the number line

Comparing Numbers

The student should be able to:

1. Demonstrate how to determine the largest number when some numbers are expressed in fractional form with denominators 4, 5, or 100 and others in decimal form to the hundredths place

2. Order numbers from largest to smallest or vice versa when some of the numbers are expressed as mixed decimals and others as fractions with denominators of either 4, 5, or 100

Betweenness Using Hundredths

The student should be able to:

1. Name a decimal between two given numbers

2. Name two whole numbers between which a given decimal lies

3. Demonstrate betweenness on a number line

Rounding Decimal Numbers to Tenths

The student should be able to:

1. Name and identify a number which has been rounded to the nearest tenth

2. Apply the following principles to construct a number rounded to the nearest tenths place:

   a. Consider the numbers named in the tenths place and the hundredths place. If the number named in the hundredths place is less than 0.05, then replace the digits right of the tenths place by 0

Page

b. If the number named in the hundredths place is 0.05 or greater, then replace the digits at the right of the tenths place by 0 and increase the number named in tenths place by 0.1

Simplifying Decimal Numerals

The student should be able to:

1. Name and identify the simplest fractional numeral for a given decimal where the fractional numeral can be named as $\frac{\text{whole number}}{100}$

2. Construct the simplest fractional numeral for a given decimal where the fractional numeral can be named as $\frac{\text{whole number}}{100}$

Column Form Addition

The student should be able to: FO-92

1. Demonstrate how to construct sums of up to four numbers named by a three digit numeral each of which contains a hundredths digit

2. Demonstrate how to construct sums of up to four numbers named by a three digit numeral some of which contain a hundredths digit

3. Construct sums of up to and including four numbers named by a three digit numeral using hundredths

Arrange Addends in Column Form

The student should be able to:

1. Demonstrate how to arrange a given number of addends in column form to preserve place value

2. State the principle that the decimal points must remain in a straight line to preserve place value

Subtraction - No Renaming

The student should be able to:

1. Demonstrate how to construct the difference of two numbers named by a four digit numeral each of which contains a hundredths digit

2. Construct the difference of two numbers named by a four digit numeral

Subtraction - Renaming

The student should be able to:

1. Demonstrate how to construct the difference of two numbers named by a four digit numeral each of which contains a hundredths digit

2. Construct the difference of two numbers named by a four digit numeral each of which contains a hundredths digit

Subtraction - No Renaming, Annexing Zeros

The student should be able to:

1. Demonstrate how to construct the difference of two numbers where the subtrahend contains a digit in the hundredths place

2. Construct the difference of two numbers where the subtrahend contains a digit in the hundredths place

Arrange a Subtraction Problem in Vertical Form

The student should be able to:

1. Demonstrate how to arrange a subtraction problem in vertical form where the hundredths digit is used in some numbers

2. State the principle that the decimal points are in a straight line to preserve place value

Multiplication by .01

The student should be able to:

1. Demonstrate how to construct products using the factor .01

Page

FO-92

2. State the principle that when .01 is used as a factor the product is found by moving the decimal point two places to the left

3. Apply the principle to construct products using a factor of .01

Products of Decimals and Whole Numbers

The student should be able to:

1. Demonstrate how to construct products using a two digit decimal factor and a two digit whole number factor

2. Demonstrate how to construct products using a two digit decimal factor and a three digit whole number factor

3. Demonstrate how to construct products using a two digit whole number factor and a three digit decimal factor. The mixed decimal factor should contain a hundredths digit

4. Construct products using a two digit factor and a three digit factor. One factor should be a decimal and the other a whole number factor. The decimal should contain a hundredths digit

Products of Two Decimals

The student should be able to:

1. Demonstrate how to construct products using a one digit and two digit decimal factor

2. Construct products using a one digit and a two digit decimal factor

Division of a Decimal Fraction by a Whole Number

The student should be able to:

1. Demonstrate how to construct quotients using a two digit divisor and a decimal dividend containing a hundredths digit, no remainders

2. Demonstrate how to construct quotients using a two digit divisor and a mixed decimal dividend which contains a hundredths digit, no remainder

Page

3. Construct quotients using divisors of one or two digits and a decimal dividend which contains a hundredths digit, no remainder

Division of a Whole Number by a Decimal Fraction

The student should be able to:

1. Demonstrate how to construct quotients using a one digit divisor containing a tenths digit and a whole number dividend, no remainder
2. Construct quotients using a one digit divisor containing a tenths digit and a whole number dividend, no remainder

Division of a Decimal by a Decimal

The student should be able to:

1. Demonstrate how to construct quotients using a one digit divisor containing a tenths digit and a dividend which contains a tenths digit, no remainders
2. Construct quotients using a one digit divisor containing a tenths digit and a dividend which contains a tenths digit, no remainders

Decimal Equivalents

The student should be able to:

1. Name and identify any fraction with a whole number as the numerator and a denominator of four or five
2. Demonstrate how to use division to construct decimal numerals for fractions with denominators of four or five
3. Construct a decimal numeral when given a fraction with denominators of four or five

UNIT SQUARE ROOT GRADE(S) Seven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Square Numbers	7	7	7	7	7					7
Vocabulary	7	7								

SQUARE ROOT - Grade 7

Page

Square Numbers

The student should be able to:

1. Name and identify square numbers

2. Demonstrate how to find square numbers that are less than or equal to 100 by showing the two equal factors or by constructing geometric diagrams using discs

3. Construct a square number by multiplying a number by itself

4. Describe a square number as a number that has exactly two equal factors, or through specific examples

5. Distinguish between square and non-square numbers

Vocabulary

The student should be able to:

1. Name and identify the terms square, square number, and equal factors

FRONT-END ADDITION

Teacher Commentary

I. Unit: Fundamental Operations - Addition of Whole Numbers

II. Objectives: The student should be able to:

Construct the sum of whole numbers.

III. Procedure:

A. Motivation:

1. Present the following addition problem to the class:

$$\begin{array}{r} \$28.74 \\ 65.86 \\ 97.13 \\ \underline{8.98} \end{array}$$

2. Let the class work it in the conventional manner. Discuss their results and the difficulties they may have had in working the problem.

3. Tell them that many businessmen use another method for adding. This method is called front-end addition. With front-end addition we do not have to worry about carrying.

B. Present the steps for using front-end addition:

1. Write the numbers in the conventional column order, making certain the columns are straight and there is space between the columns. See example.

2. Draw lines vertically between the columns and extend them several lines below the problem.

3. Add the first column to the left (2 + 6 + 9) and record the total in the column directly under the problem

4. Add the second column (8 + 5 + 7 + 8) and record the total on the next line down. Since the sum has two digits, place the digit on the right in the column in which you are adding and the digit on the left in the left-hand column.

5. Add the third column (7 + 8 + 1 + 9). Again the sum has two digits. Place the sum on the third line in the same manner described in Step 4.

6. Add the last column (4 + 6 + 3 + 8). Place the sum on the fourth line in the same manner.

7. Now total the partial sums as you did the columns. If any sum is two digits write it on the line below and place the numerals in the proper columns.

8. Now complete the final total.

Steps 1 and 2

	$2	8 .	7	4
	6	5 .	8	6
	9	7 .	1	3
		8 .	9	8
Step 3	17			
Step 4	2	8		
Step 5		2	5	
Step 6			2	1
	19		7	1
Step 7	1	0		
Step 8	$20	0 .	7	1

C. Let the pupils work several examples as a group in this manner until they fully understand the procedure.

D. Pupils may then practice doing addition examples independently using the front-end method.

PRACTICE IN ADDITION

Teacher Commentary

A Tape Recording of Addition Problems for use in Grade 7

I. Materials:

A. Tape recorder

B. Eight-station listening post (optional)

C. Tape entitled, "Practice In Addition"

D. Work sheet entitled, "Practice In Addition"

E. Pencil and eraser

II. Procedure:

A. Preview the tape to determine if it will be used with a small group of students, or if it will be used as a class activity.

B. The tape has ten problem sets. Each problem set has ten addition problems in it. Do not do all problem sets at the same time. The tape has been designed so a student could do two or three problem sets at one sitting. Each problem set is approximately 2 minutes long.

C. Make an analysis of the problems done incorrectly to determine where students are having problems. A teacher copy has been supplied for this purpose.

D. The total tape time is approximately 22 minutes. Ten second intervals separate each problem set.

PRACTICE IN ADDITION

TEACHER'S COPY

	A	B	C	D	E	F	G	H	I	J
Example Set	1 + 1 2	0 + 2 2	2 + 1 3	0 + 1 1	3 + 2 5	0 + 0 0	2 + 0 2	1 + 2 3	0 + 1 1	2 + 3 5
Problem Set 1	4 + 1 5	1 + 0 1	1 + 3 4	3 + 0 3	0 + 4 4	1 + 4 5	0 + 3 3	5 + 0 5	2 + 2 4	3 + 1 4
Problem Set 2	4 + 0 4	0 + 5 5	3 + 4 7	2 + 8 10	8 + 2 10	5 + 2 7	7 + 2 9	6 + 4 10	6 + 2 8	4 + 2 6
Problem Set 3	7 + 3 10	2 + 4 6	4 + 3 7	5 + 4 9	2 + 5 7	1 + 5 6	4 + 5 9	4 + 4 8	3 + 3 6	5 + 3 8
Problem Set 4	3 + 6 9	5 + 1 6	4 + 6 10	7 + 1 8	6 + 1 7	2 + 7 9	3 + 5 8	2 + 6 8	5 + 5 10	1 + 7 8
Problem Set 5	1 + 6 7	0 + 7 7	6 + 0 6	3 + 7 10	0 + 6 6	7 + 0 7	1 + 8 9	9 + 1 10	0 + 8 8	1 + 9 10
Problem Set 6	8 + 0 8	0 + 9 9	9 + 0 9	8 + 1 9	6 + 3 9	9 + 2 11	8 + 3 11	9 + 3 12	7 + 4 11	9 + 4 13
Problem Set 7	8 + 4 12	6 + 4 10	8 + 2 10	7 + 3 10	5 + 5 10	6 + 6 12	8 + 6 14	4 + 6 10	9 + 6 15	7 + 6 13
Problem Set 8	6 + 5 11	9 + 5 14	7 + 5 12	5 + 6 11	8 + 5 13	6 + 8 14	7 + 8 15	5 + 7 12	8 + 8 16	4 + 7 11
Problem Set 9	7 + 7 14	6 + 7 13	3 + 7 10	8 + 7 15	4 + 9 13	9 + 1 10	6 + 9 15	3 + 8 11	5 + 9 14	9 + 8 17
Problem Set 10	9 + 7 16	2 + 8 10	4 + 8 12	7 + 9 16	5 + 8 13	9 + 9 18	8 + 9 17	3 + 9 12	2 + 9 11	1 + 9 10

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Name ______________________

Section ______________________

PRACTICE IN ADDITION

	A	B	C	D	E	F	G	H	I	J
Example Set										
Problem Set 1										
Problem Set 2										
Problem Set 3										
Problem Set 4										
Problem Set 5										
Problem Set 6										
Problem Set 7										
Problem Set 8										
Problem Set 9										
Problem Set 10										

PRACTICE IN SUBTRACTION

Teacher Commentary

A Tape Recording of Subtraction Problems for Use in Grade 7

I. Materials:

A. Tape recorder

B. Eight-station listening post (optional)

C. Tape entitled "Practice In Subtraction"

D. Work sheet entitled "Practice In Subtraction"

E. Pencil and eraser

II. Procedure:

A. Preview the tape to determine if it will be used with a small group of students, or if it will be used as a class activity.

B. The tape has ten problem sets. Each problem set has ten subtraction problems in it. Do not do all problem sets at the same time. The tape has been designed so a student could do two or three problem sets at one sitting. Each problem set is approximately 2 minutes long.

C. Make an analysis of the problems done incorrectly to determine where students are having problems. A teacher copy has been supplied for this purpose.

D. The total tape time is approximately 20 minutes. Ten second intervals separate each problem set.

E. Provide one or more practice examples so that students will be familiar with the format of the answer sheet.

PRACTICE IN SUBTRACTION

TEACHER'S COPY

	A	B	C	D	E	F	G	H	I	J
Example Set	1 - 1 0	3 - 1 2	1 - 0 1	3 - 3 0	4 - 3 1	0 - 0 0	5 - 2 3	2 - 1 1	4 - 4 0	4 - 0 4
Problem Set 1	5 - 1 4	5 - 5 0	3 - 2 1	4 - 1 3	2 - 0 2	5 - 4 1	4 - 2 2	5 - 3 2	2 - 2 0	5 - 0 5
Problem Set 2	3 - 0 3	6 - 6 0	8 - 0 8	8 - 8 0	10 - 9 1	10 - 1 9	9 - 9 0	6 - 5 1	7 - 0 7	8 - 2 6
Problem Set 3	9 - 8 1	6 - 1 5	9 - 1 8	6 - 0 6	8 - 1 7	7 - 1 6	7 - 6 1	9 - 0 9	8 - 7 1	6 - 2 4
Problem Set 4	10 - 3 7	10 - 5 5	6 - 3 3	10 - 4 6	7 - 2 5	6 - 4 2	10 - 2 8	10 - 7 3	10 - 6 4	10 - 8 2
Problem Set 5	8 - 4 4	9 - 7 2	9 - 5 4	7 - 4 3	9 - 4 5	7 - 5 2	9 - 3 6	7 - 3 4	9 - 6 3	7 - 7 0
Problem Set 6	8 - 5 3	8 - 3 5	8 - 6 2	9 - 2 7	10 - 1 9	10 - 9 1	10 - 3 7	10 - 5 5	11 - 9 2	10 - 4 6
Problem Set 7	12 - 9 3	14 - 9 5	10 - 2 8	18 - 9 9	12 - 6 6	14 - 7 7	10 - 8 2	12 - 4 8	10 - 7 3	11 - 2 9
Problem Set 8	10 - 6 4	16 - 8 8	12 - 8 4	11 - 4 7	12 - 5 7	13 - 7 6	15 - 9 6	14 - 6 8	15 - 8 7	13 - 8 5
Problem Set 9	11 - 6 5	13 - 9 4	17 - 8 9	11 - 5 6	15 - 7 8	16 - 7 9	14 - 8 6	11 - 8 3	13 - 4 9	15 - 6 9
Problem Set 10	12 - 3 9	14 - 5 9	16 - 9 7	11 - 7 4	13 - 6 7	11 - 3 8	13 - 5 8	17 - 9 8	12 - 7 5	15 - 6 9

Name ______________________

Section ______________________

PRACTICE IN SUBTRACTION

	A	B	C	D	E	F	G	H	I	J
Example Set										
Problem Set 1										
Problem Set 2										
Problem Set 3										
Problem Set 4										
Problem Set 5										
Problem Set 6										
Problem Set 7										
Problem Set 8										
Problem Set 9										
Problem Set 10										

NOMOGRAPH
MULTIPLY-DIVIDE WHOLE NUMBERS

Teacher Commentary

I. Unit: Fundamental Operations

II. Objectives: The student should be able to:

Demonstrate how to construct the product and quotient of two whole numbers using the nomograph

III. Materials:

A. Student work sheet "Nomograph"

B. A twelve inch ruler

IV. Procedure:

A. Distribute the materials to each student.

B. Discuss the three scales A, B and C.

1. Scales A and B begin with one and end with ten.

2. Scale C begins with one and ends with one hundred.

3. Each student should be able to locate given points on each scale and read given points on each scale before learning how to compute.

C. In order to multiply any two numbers, locate one number on scale A and the other on scale B. The line joining these two points will cross scale C at a point that represents the product.

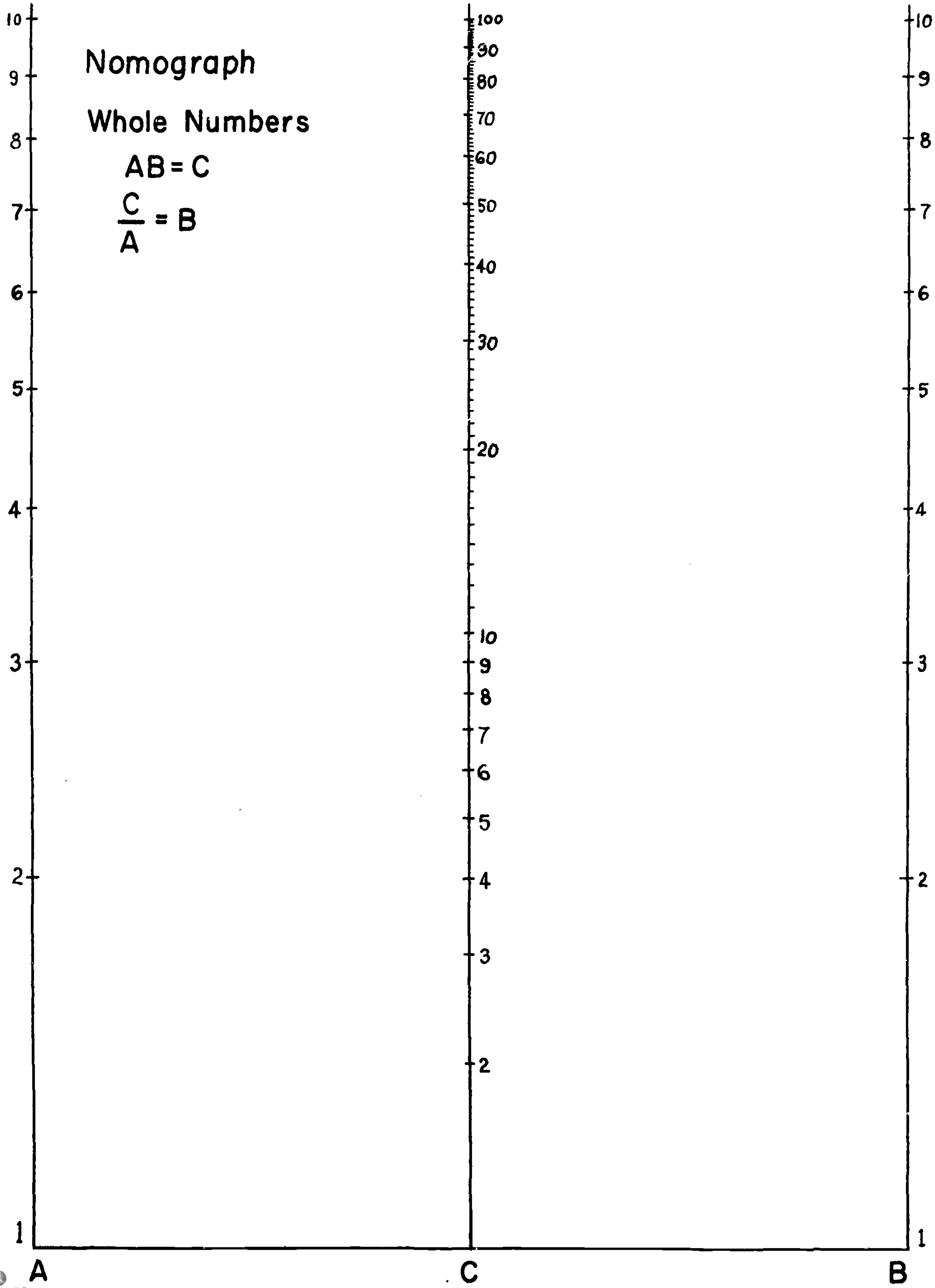
D. In order to divide any two numbers, rename the division problem as an equivalent fraction. e.g. $2\overline{)4}$, $\frac{4}{2}$. Locate the numerator on scale C and the denominator on scale A. The line joining these two points will cross the B scale at a point that represents the quotient.

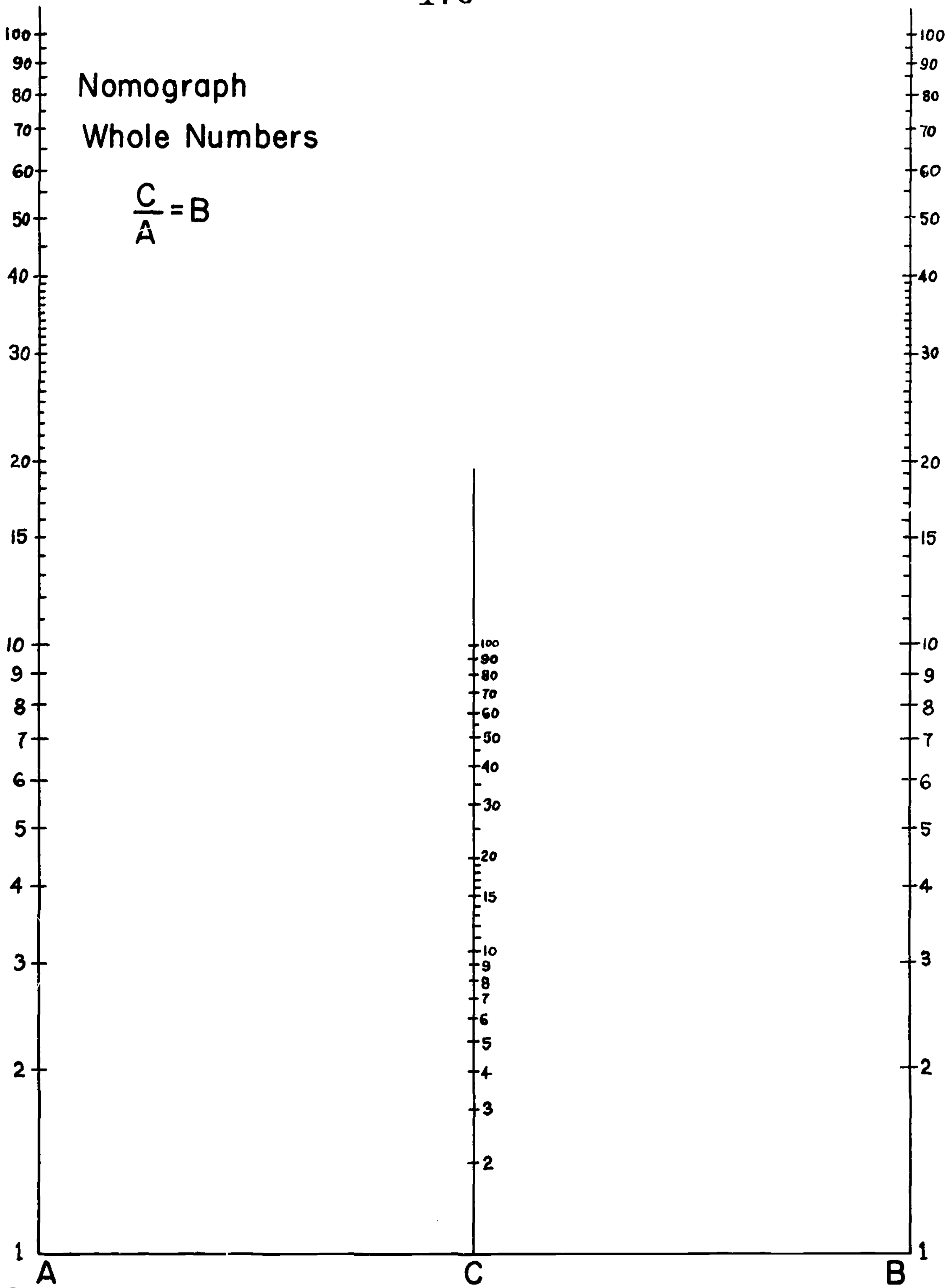
D. Be sure to select examples whose answer may be found on the nomograph. A second nomograph can be used for division. No restrictions have to be placed on its use.

E. This nomograph could be used to find the area of a square, rectangle, and parallelogram.

	A Scale	B Scale	C Scale
square	s = 4	s = 4	64 sq. units
rectangle	l = 5	w = 6	30 sq. units
parallelogram	b = 20	h = 6	120 sq. units

F. After the students have completed some written exercises they could use the nomograph to check their results.


Nomograph
Whole Numbers
AB = C
C/A = B
A
C
B
1
2
3
4
5
6
7
8
9
10
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100


Nomograph
Whole Numbers
C/A = B
A
C
B

PRACTICE IN MULTIPLICATION

Teacher Commentary

A Tape Recording of Multiplication Problems for Use in Grade 7

I. Materials:

A. Tape recorder

B. Eight-station listening post (optional)

C. Tape entitled, "Practice In Multiplication"

D. Work sheet entitled, "Practice In Multiplication"

E. Pencil and eraser

II. Procedure:

A. Preview the tape to determine if it will be used with a small group of students, or if it will be used as a class activity.

B. The tape has ten problem sets. Each set has ten multiplication problems in it. Do not do all problem sets at the same time. The tape has been designed so a student could do two or three problem sets at one sitting. Each problem set is approximately 2 minutes long.

C. Make an analysis of the problems done incorrectly to determine where students are having problems. A teacher copy has been supplied for this purpose.

D. The total tape time is approximately 20 minutes. Ten second intervals separate each problem set.

E. Provide one or more practice examples so that students will be familiar with the format of the answer sheet.

PRACTICE IN MULTIPLICATION

TEACHER'S COPY

	A	B	C	D	E	F	G	H	I	J
Example Set	1 x 0 0	0 x 7 0	8 x 0 0	6 x 0 0	0 x 6 0	0 x 4 0	3 x 0 0	0 x 9 0	0 x 8 0	4 x 0 0
Problem Set 1	0 x 1 0	0 x 2 0	0 x 5 0	8 x 0 0	0 x 3 0	5 x 0 0	0 x 0 0	2 x 0 0	4 x 1 4	1 x 3 3
Problem Set 2	5 x 1 5	1 x 7 7	9 x 1 9	7 x 1 7	1 x 8 8	1 x 6 6	8 x 1 8	1 x 2 2	6 x 1 6	1 x 4 4
Problem Set 3	3 x 1 3	1 x 9 9	2 x 1 2	1 x 5 5	1 x 1 1	2 x 6 12	2 x 9 18	4 x 2 8	2 x 8 16	9 x 2 18
Problem Set 4	2 x 2 4	2 x 3 6	2 x 4 8	7 x 2 14	2 x 7 14	5 x 2 10	2 x 5 10	8 x 2 16	6 x 2 12	3 x 2 6
Problem Set 5	5 x 3 15	4 x 3 12	7 x 3 21	3 x 7 21	3 x 8 24	3 x 4 12	3 x 9 27	3 x 6 18	8 x 3 24	3 x 3 9
Problem Set 6	6 x 3 18	9 x 3 27	3 x 5 15	4 x 6 24	4 x 8 32	5 x 4 20	9 x 4 36	7 x 4 28	4 x 4 16	8 x 4 32
Problem Set 7	4 x 7 28	4 x 5 20	6 x 4 24	4 x 9 36	5 x 5 25	5 x 6 30	5 x 8 40	9 x 5 45	7 x 5 35	6 x 5 30
Problem Set 8	5 x 7 35	8 x 5 40	5 x 9 45	7 x 6 42	9 x 6 54	6 x 8 48	6 x 6 36	6 x 7 42	8 x 6 48	7 x 9 63
Problem Set 9	7 x 7 49	7 x 8 56	6 x 9 54	9 x 7 63	8 x 7 56	9 x 9 81	8 x 8 64	9 x 8 72	8 x 9 72	10x 7 70
Problem Set 10	20x 3 60	40x 2 80	60x 4 240	20x 5 100	30x 6 180	100x8 800	200x4 800	300x2 600	1000x6 6000	3000x3 9000

Name ______________________________

Section ______________________________

PRACTICE IN MULTIPLICATION

	A	B	C	D	E	F	G	H	I	J
Example Set										
Problem Set 1										
Problem Set 2										
Problem Set 3										
Problem Set 4										
Problem Set 5										
Problem Set 6										
Problem Set 7										
Problem Set 8										
Problem Set 9										
Problem Set 10										

DIVISION A LA GUESSING

Teacher Commentary

I. Unit: Fundamental Operations: Division

II. Objectives: The student should be able to:

- A. Demonstrate how to find quotients with remainders where the divisor is a number named by a two digit numeral
- B. Construct a quotient with a remainder where the division is a number named by a two digit numeral

III. Procedure:

- A. This material may be used by an entire class or by small groups depending upon their need. Students must be able to multiply numbers easily by multiples of 10.
- B. Students should be presented with a division example, written on the board. This should be discussed and students given an opportunity to make guesses as to what the quotient might be.
- C. The quotient should then be found by demonstrating and describing the method of taking a series of educated guesses and adding the results.

  Example: 27) 1987

```
      73 r 16
27) 1987              27) 1987              27) 1987
     270    10             540    20             1080    40
    ----                  ----                   ----
    1717                  1447                    907
     540    20             810    30              810    30
    ----                  ----                   ----
    1177                   637                     97
     540    20             540    20               54     2
    ----                  ----                   ----
     637                    97                     43
     540    20              54     2               27     1
    ----                  ----                   ----   ----
      97                    43                     16    73
      54     2              27     1
    ----                  ----   ----
      43                    16    73
      27     1
    ----   ----
      16    73
```

- D. From the above example, the teacher and student should observe that the problem becomes easier if a person can learn how to "think big" but not too big. The problem was shortened by beginning with a trial divisor of 40 as opposed to 10.

E. After the student have worked several examples in this way, the following method of picking a trial divisor can be discussed.

Example: 27) 1987

1. Construct a multiplication table using the divisor as one of the factors:

   10 x 27 = 270
   100 x 27 = 2700

2. Compare the dividend in the example with the products in the table. These products show that the quotient is a number named by a two digit numeral.

3. The students may then try 50 x 27 = 1350.

4. Compare the dividend in the example with this product.

   a. Since the dividend is greater the students may use 50 as a trial quotient.

   b. Some students may want to be more exact and try the following:

      60 x 27 = 1740

      70 x 27 = 1890

      80 x 27 = 2160

   70 is the largest trial quotient to use as the product of 80 x 27 is larger than the dividend.

F. Students should be given the opportunity to work examples in this manner both at their seats and at the board.

NOMOGRAPH
ADD-SUBTRACT FRACTIONS

Teacher Commentary

I. Unit: Fundamental Operations

II. Objectives: The student should be able to:

A. Demonstrate how to construct the sum and difference of two whole numbers using the nomograph

B. Demonstrate how to construct the sum and difference of two fractions and/or mixed forms using the nomograph

III. Materials:

A. Student work sheet "Nomograph"

B. A twelve inch ruler

IV. Procedure:

A. Distribute the materials to each student.

B. Discuss the three scales A, B and C.

1. Scales A and B begin with zero and end with ten. Each unit is divided into fourths.

2. Scale C begins with zero and ends with twenty. Each unit is divided into fourths.

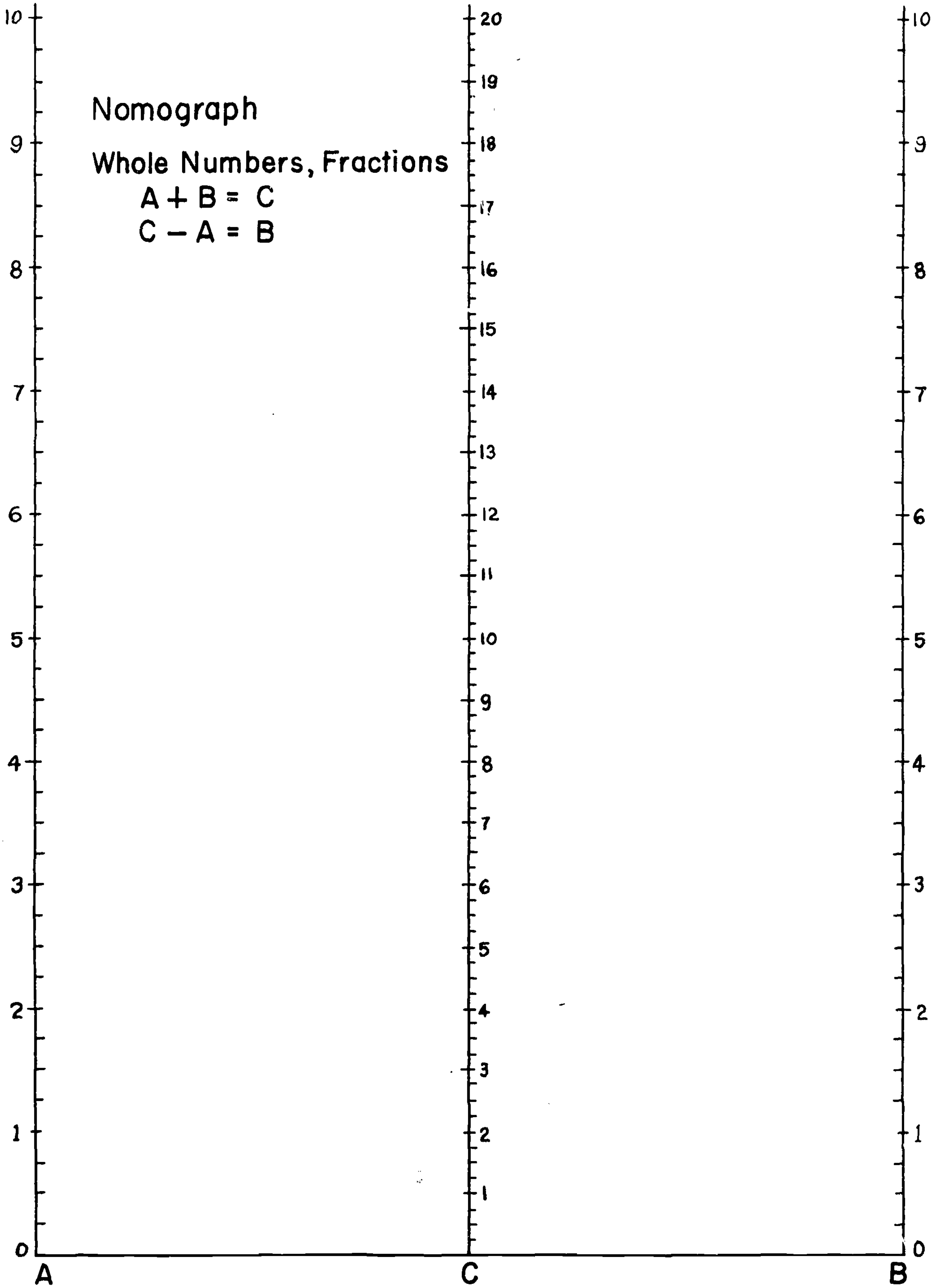
3. Each student should be able to locate given points on each scale and read given points on each scale before learning how to compute.

C. In order to add any two numbers, locate one number on scale A and the other on scale B. The line joining these two points will cross scale C at a point that represents the sum.

D. In order to subtract any two numbers, locate the minuend on the C scale and the subtrahend on the A scale. The line joining these two points will cross scale B at a point that represents the difference.

E. Be sure to select problems whose answers may be found on the nomograph. This nomograph may be used to find the sum and difference of any two fractions. Only halves and quarters will be considered when adding or subtracting fractions and/or mixed forms.

F. After the students have completed some written exercises they could use the nomograph to check their results.


Nomograph
Whole Numbers, Fractions
A + B = C
C − A = B
A
C
B

NOMOGRAPH
ADD-SUBTRACT DECIMALS

Teacher Commentary

I. Unit: Fundamental Operations

II. Objectives: The student should be able to:

Demonstrate how to construct the sum and difference of two decimal fractions using the nomograph

III. Materials:

A. Student work sheet "Nomograph"

B. A twelve inch ruler

IV. Procedure:

A. Distribute the materials to each student.

B. Discuss the three scales A, B and C.

1. Scales A and B begin with zero and end with eight. Each unit is divided into tenths.

2. Scale C begins with zero and ends with sixteen. Each unit is divided into tenths.

3. Locate some points on the scales and have the students identify them.

4. Have the students locate points on the scales.

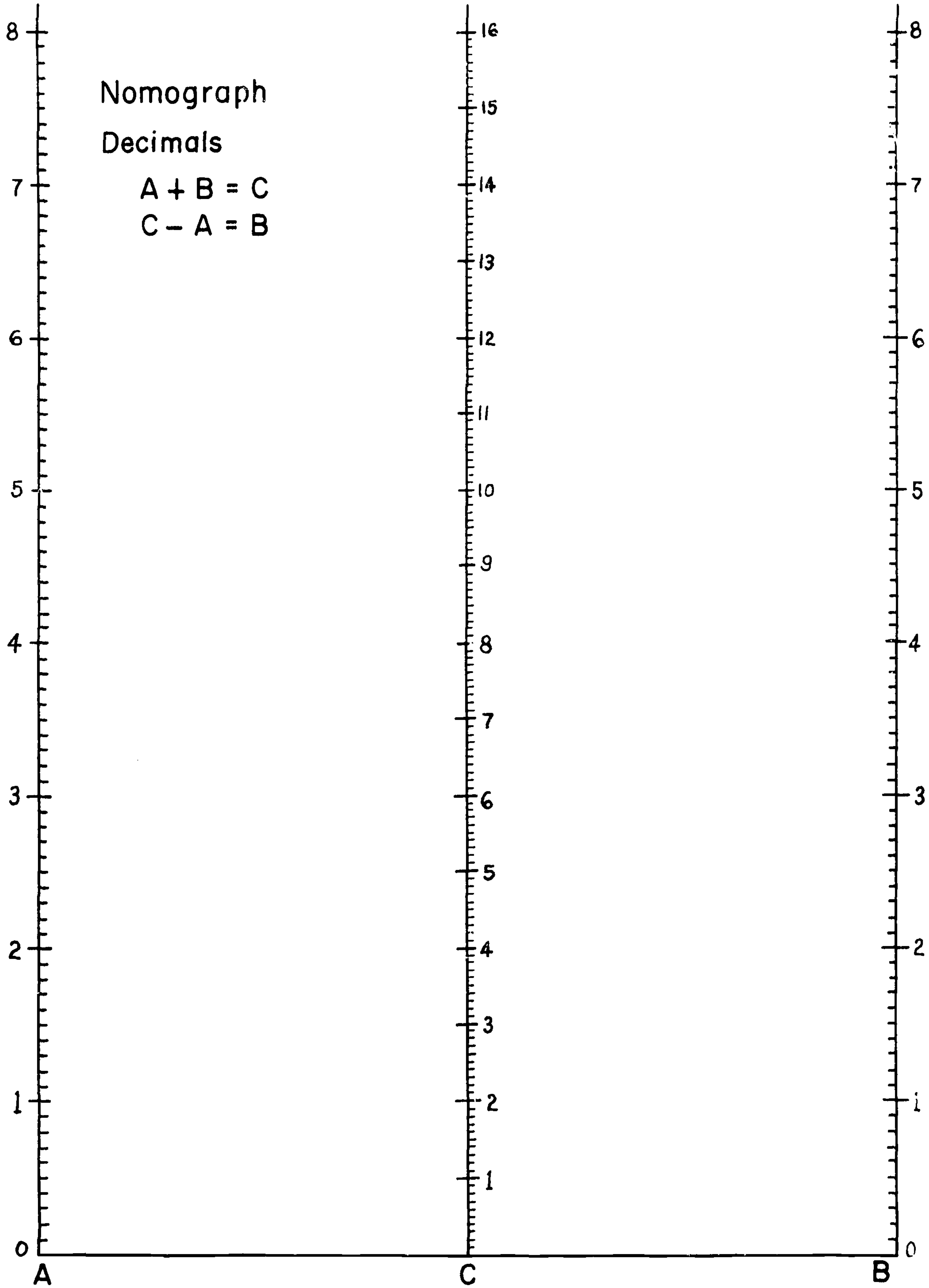
5. Students have to be able to locate and identify given points before learning how to compute.

C. In order to add 2.2 + 5.7 locate 2.2 on scale A and 5.7 on scale B. The line joining these two points will cross scale C at a point that represents the sum (7.9).

D. In order to subtract 4.6 from 6.3, locate 6.3 on scale C (minuend) and 4.6 on scale A (subtrahend). The line joining these two points will cross scale B at a point that represents the difference (1.7). Be sure to select problems whose answer may be found on the nomograph.

E. This nomograph may also be used to determine change. The total amount of money would be located on scale C and the amount spent would be found on scale A. The change would be found on scale B.

F. After the students have completed some written exercises, they could use the nomograph to check their results.


Nomograph
Decimals
A + B = C
C − A = B
A
C
B

COMOGRAPH - L. C. M.

Teacher Commentary

I. Unit: Fundamental Operations

II. Objectives: The student should be able to:

Demonstrate how to construct the least common multiple for a pair of numbers using the comograph

III. Materials:

A. Student work sheet "Comograph"

B. A twelve inch ruler

IV. Procedure:

A. Distribute the materials to each student.

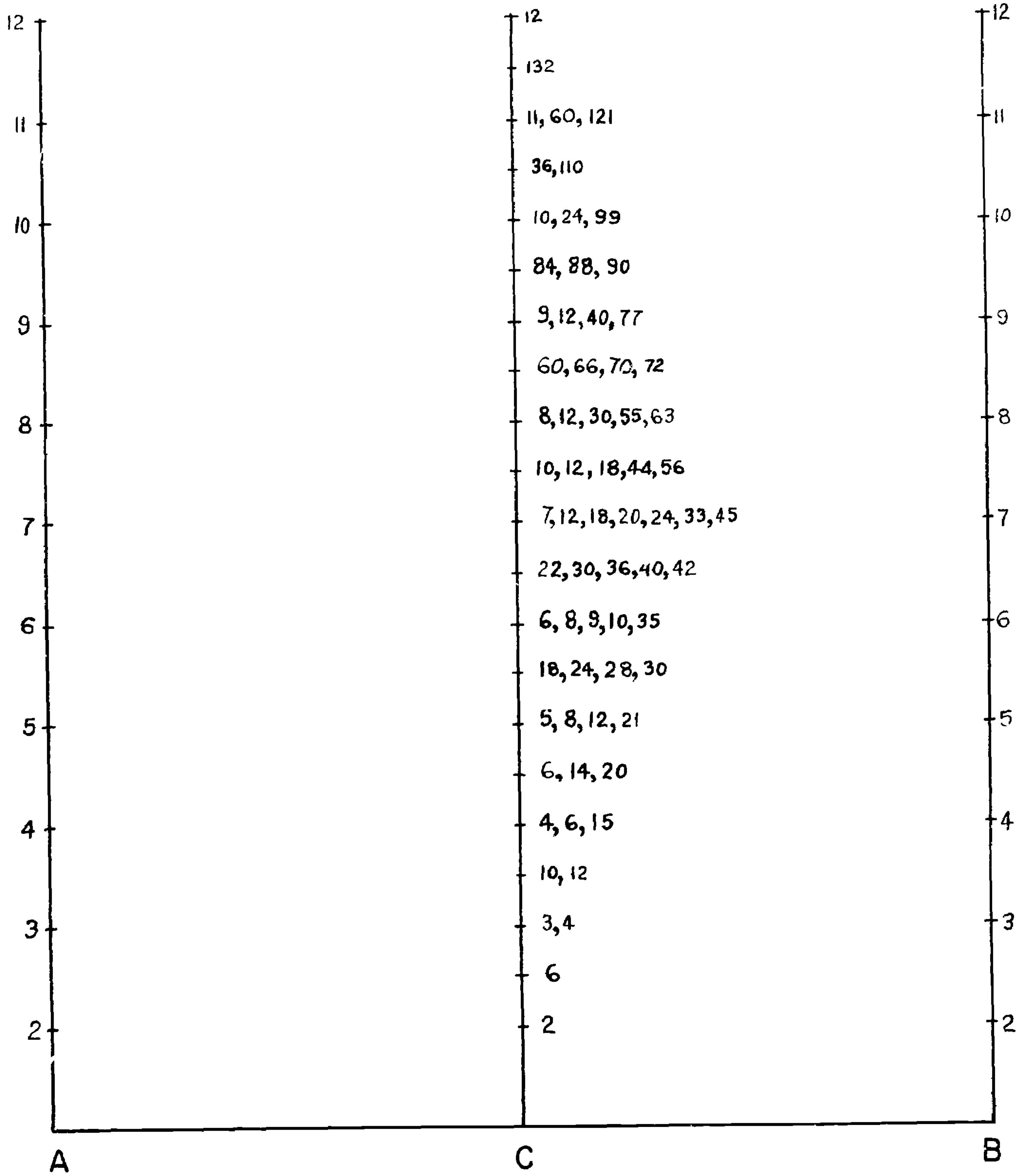
B. Discuss the three scales A, B and C.

1. Scales A and B begin with two and end with twelve.
2. Scale C is divided into twenty-one equal parts. Each point on scale C may have one or more numbers associated with it.
3. Locate some points on the scales and have the students identify them.
4. Have students locate points on the scales.

C. In order to find the least common multiple of 6 and 9 locate 6 on scale A and 9 on scale B. The line joining these two points will cross scale C at a point which represents the least common multiple. In this specific case, there are five possible choices: 10, 12, 18, 44 and 56. Find the smallest number which is divisible by both 6 and 9. The answer in this case is 18.

Comograph

Least Common Multiple



NOMOGRAPH
ADD-SUBTRACT DENOMINATE NUMBERS
Teacher Commentary

I. Unit: Fundamental Operations

II. Objectives: The student should be able to:

Demonstrate how to construct the sum and difference of two denominate numbers using the nomograph

III. Materials:

A. Student work ,t "Nomograph"

B. A twelve inch ruler

IV. Procedure

A. Distribute the materials to each student.

B. Discuss the three scales A, B and C.

1. Scales A and B begin with zero and end with either six feet or two yards. Each unit is divided into twelfths.

2. Scale C begins with zero and ends with either twelve feet or four yards. Each unit is divided into twelfths.

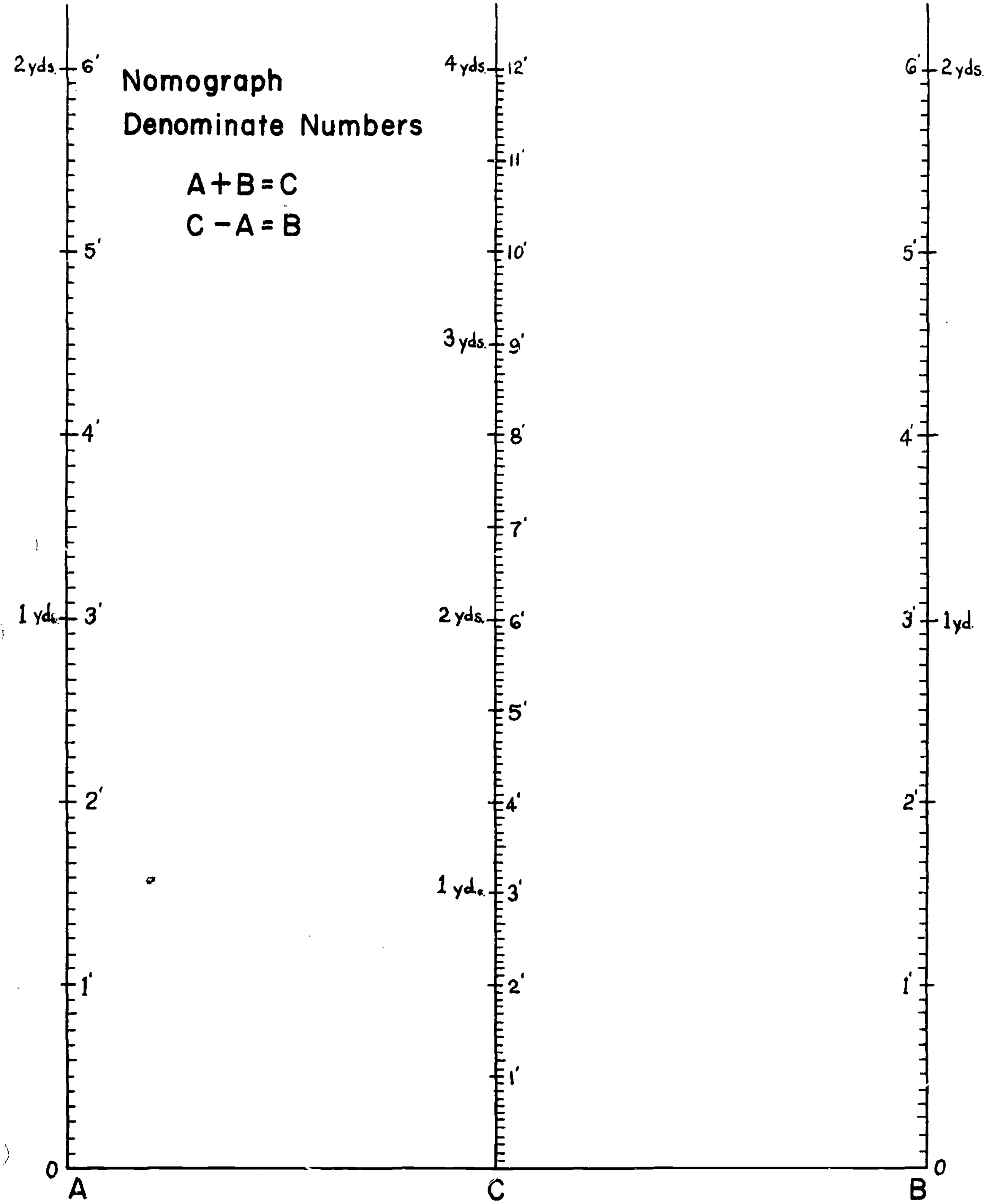
3. Locate some points on the scales and have the students identify them. Point out that the mark for three feet also represents one yard.

4. Have the students locate points on the scales.

C. In order to add any two numbers (4' 7" + 5' 10"), locate 4' 7" on scale A and 5' 10" on scale B. The line joining these two points will cross scale C at a point that represents the sum (10' 5").

D. In order to subtract any two numbers (3 yd. 1' 3" - 1 yd. 2' 9"), locate the minuend (3 yd. 1' 3") on scale C and the subtrahend (1 yd. 2' 9") on scale A. The line joining these two points will cross scale B at a point that represents the difference (1 yd 1' 6"). Be sure to select problems whose answer may be found on the nomograph.

E. After the students have completed some written exercises, they could use the nomograph to check their results.



Nomograph
Denominate Numbers
A+B=C
C-A=B
2 yds. 6'
5'
4'
1 yd. 3'
2'
1'
0
A
4 yds. 12'
11'
10'
3 yds. 9'
8'
7'
2 yds. 6'
5'
4'
1 yd. 3'
2'
1'
C
6' 2 yds.
5'
4'
3' 1 yd.
2'
1'
0
B

VERBAL PROBLEMS - 1

Teacher Commentary

A Tape Recording of Verbal Problems for Use in Grade 7

I. Materials:

A. Tape recorder

B. Eight-station listening post (optional)

C. Tape entitled, "Verbal Problems - 1"

D. Paper

E. Pencil and eraser

II. Procedure:

A. Preview the tape to determine if it will be used with a small group of students, or if it will be used as a class activity.

B. The tape has 15 problems, and is 7 minutes long.

C. Following the presentation of each problem, the answer is given after a suitable interval.

D. Two additional tapes of similar design are also available - Part 2 presented in grade 8 and Part 3 presented in grade 9.

GEOMETRY

GEOMETRY

I. Master Chart - Grades Six through Eleven

II. Grade Seven Chart

III. Behavioral Objectives

IV. Activities

UNIT GEOMETRY GRADE(S) Six through Ten

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Point	6	6		6						
Line	6	6		6	6					
Plane	6	6		7	6					
Closed Path	6	6		6	6					6
Segment	6, 7	6, 7	7	6, 7	6					6
Congruent Segments	9	9	9		9					
Ray	6, 7	6, 7		6	6					6
Angles	6, 7	6, 7	7	6	6					
Vertex	7	7			7					
Right Angles	6	6	9	6	6					9
Acute Angles	9	9		9	9					9
Obtuse Angles	9	9		9	9					9
Straight Angles	9	9		9	9					9
Vertical Angles	9	9		9	9	9	9			
Supplementary Angles	9	9		9	9					9
Complementary Angles	9	9		9	9					9
Congruent Angles	9	9	9	9	9					
Triangles	6, 7	6, 7	10	6	6					

UNIT GEOMETRY GRADE(S) Seven through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Equilateral Triangle	8	8	8	8	8					8
Isosceles Triangle	8	8	8	8	8					8
Scalene Triangle	8	8	8	8	8					8
Right Triangle	9	9	9	9	9					9
Acute Triangle	9	9		9	9					9
Obtuse Triangle	9	9		9	9					9
Perpendicular Lines	9	9	9	9	9					
Parallel Lines	7	7	9	7	7					7
Transversal	10	10		10	10					
Corresponding Angles	10	10		10		10	10, 11			
Midpoint	7	7	7		7					
Partitioning a Segment			11							
Quadrilaterals	7	7		7	7					
Trapezoid	7	7		7	7					7
Parallelogram	7	7	10	7	7	10	10, 11			7
Rectangles	7	7	10	7	7	10	10, 11			7
Square	7	7	10	7	7	10	10, 11			7
Rhombus	7	7	10	7	7	10	10, 11			7
Polygon	8	8		8	8					

UNIT GEOMETRY GRADE(S) Eight through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Pentagon	8	8	9	8	8				8	8
Hexagon	8	8	8	8	8				8	8
Octagon	8	8	8,9	8	8				8	8
Congruent Triangles	10	10			10	10	10			
Similar Triangles	10	10			10	10	10			
Corresponding Sides of Similar Triangles						10	10, 11	10, 11		
Circle	6	6	7	6	6					
Radius	6	6	7	6	6	7				
Diameter	6	6	7	6	6	7				
Chord	7	7	7	7	7					
Tangent	8	8	10	8	8	10				8
Secant	8	8		8	8					8
Central Angle	10	10	10	10	10					10
Inscribed Angle	10	10	10	10	10	10				10
Ellipse	10	10	10	10	10	10				
Angle Bisector	9	9	9	9	9	9				
Sum of Interior Angles of Triangles						9	9			
45°			9	9						
60°			9	9						

UNIT GEOMETRY GRADE(S) Seven through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
30°			9	9						
Median Triangle	7	7	7	7	7	7				
Altitude of Triangle	9	9	9	9	9					
Cube	7	7		7	7					7
Rectangular Solid	7	7		7	7					
Pyramid	8	8		8	8					
Cone	8	8		8	8					
Cylinder	8	8		8	8					
Sphere	8	8		8	8					8
Line of Symmetry	8	8		8	8					
Sum of Interior Angles of Quadrilaterals						9	9			
Sin	11	11				11	11	11		11
Cos	11	11				11	11	11		11
Tan	11	11				11	11	11		11
Trig Tables	11	11		11				11		
Other Polyhedrons	11	11		9, 10						
Pythagorean Theorem						10	10			
Region	7	7		7	7					
Sum of Interior Angles of a Polygon						8	8			

UNIT GEOMETRY GRADE(S) Seven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Plane				7						
Segment	7	7	7	7						
Ray	7	7								
Angles	7	7	7							
Vertex	7	7			7					
Triangles	7	7								
Parallel Lines	7	7		7	7					7
Midpoint of Segment	7	7	7		7					
Quadrilaterals	7	7		7	7					
Trapezoid	7	7		7	7					7
Parallelogram	7	7		7	7					7
Rectangles	7	7		7	7					7
Square	7	7		7	7					7
Rhombus	7	7		7	7					7
Circle			7							
Radius			7			7				
Diameter			7			7				
Chord	7	7	7	7	7					

UNIT GEOMETRY GRADE(S) Seven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Median Triangle	7	7	7	7	7	7				
Cube	7	7		7	7					7
Rectangular Solid	7	7		7	7					
Region	7	7		7	7					

Page

Plane

The student should be able to:

1. Construct a drawing of a plane

Segment and Ray

The student should be able to:

1. Name and identify the symbol for segment and ray

2. Demonstrate how to construct a copy of a given segment by:

   a. Compass and straightedge

   b. Matching end points of the segment with points on a straightedge

Midpoint

The student should be able to:

1. Name and identify the midpoint of a segment

2. Demonstrate a method for determining the midpoint of a line segment by using a compass and straightedge

3. Describe a midpoint

Angle

The student should be able to:

1. Name and identify the symbol for angle

2. Demonstrate the construction of a copy of an angle by using a compass and straightedge

Vertex of an Angle

The student should be able to:

1. Name and identify the vertex of an angle GE-14

2. Describe a vertex as the point where the two rays meet

	Page
Triangles	
The student should be able to:	
1. Name and identify the symbol for a triangle	
Parallel Lines	
The student should be able to:	
1. Name and identify the figures and symbols for parallel lines	
2. Construct a drawing of parallel lines using a straightedge or freehand sketch	
3. Describe parallel lines as lines that go in the same direction, but never meet	
4. Distinguish parallel lines from non-parallel lines	
Quadrilaterals	
The student should be able to:	GE-14
1. Name and identify a quadrilateral	
2. Construct a drawing of a quadrilateral using a straightedge or freehand sketch	
3. Construct a model of a quadrilateral with available materials	GE-16
4. Describe a quadrilateral in terms of his surroundings or as a closed four sided figure	
Parallelograms, Rectangles, Squares	
The student should be able to:	GE-13
1. Name and identify the figures and symbols	GE-16
2. Construct drawings using a straightedge or freehand sketch	
3. Describe a parallelogram in terms of their surroundings or as a quadrilateral with opposite sides parallel	R-28

Page

4. Describe the rectangle and square in a variety of ways using its relationship to other geometric figures or by instances in the physical environment

5. Distinguish rectangles and squares from other quadrilaterals

Trapezoid

The student should be able to:

1. Name and identify a trapezoid

2. Construct a drawing of a trapezoid using a straightedge or freehand sketch

3. Describe a trapezoid as a quadrilateral having a pair of parallel sides — GE-16

4. Distinguish between a trapezoid and other quadrilaterals

Circle

The student should be able to:

1. Demonstrate a method of drawing a circle using a compass — GE-18

Radius

The student should be able to:

1. Demonstrate the construction of a radius with a straightedge

2. State the principle that the radius of the circle is one-half as long as the diameter

Diameter

The student should be able to:

1. Demonstrate the construction of a diameter with a straightedge

2. State the principle that the diameter of a circle is twice the length of the radius

Chord

Page

The student should be able to:

1. Name and identify the chord
2. Construct a drawing of a chord using a straightedge or freehand sketch when the circle is given
3. Demonstrate the construction of a chord by means of a straightedge when the circle is given
4. Describe the chord by definition

Median of a Triangle

The student should be able to:

1. Name and identify a median of a triangle
2. Construct a drawing of a median of a triangle using a straightedge or freehand sketch
3. Demonstrate a method for constructing a median of a triangle using a compass and a straightedge
4. Describe the median of a triangle by definition
5. State the principle that a median of a triangle is concurrent

Cube

The student should be able to:

1. Name and identify a cube
2. Construct a freehand drawing of a cube
3. Construct a model of a cube with available materials
4. Describe a cube in terms of surroundings
5. Distinguish between a cube and other rectangular solid

Page

Rectangular Solid

The student should be able to:

1. Name and identify a rectangular solid
2. Construct a freehand drawing of a rectangular solid
3. Construct a model of a rectangular solid with available materials
4. Describe a rectangular solid in terms of his surroundings

Region

The student should be able to:

1. Name and identify a region
2. Construct a freehand sketch of a region
3. Describe a region by illustration

GEOMETRY: LINES AND SHAPES

Teacher Commentary For Film

I. Unit: Geometry

II. Objectives: The student should be able to:

A. Name and identify:

1. A line segment
2. The symbol for a triangle
3. Rectangle and square figures

B. Distinguish between a rectangle and a square

C. Describe rectangles and squares in a variety of ways using their relationship to other geometric figures or by instances in the physical environment

III. Materials: Motion picture film - *Geometry: Lines and Shapes*. Film Associates; Baltimore County Central Film Library No. 352

IV. Procedure:

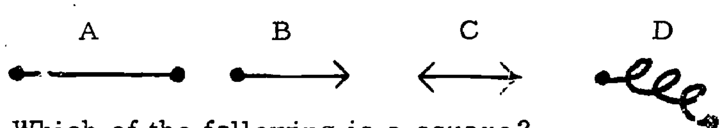
A. Use the film as an introduction or a review of line segments, rectangles, squares, and triangles.

B. Motivate the students immediately before the film.

C. List the following guide questions on the board to insure that the students know why they are viewing the film.

Examples:

1. Which of the following represents a line?



2. Which of the following is a square?

3. Describe an object in the room that has a rectangular shape.
4. Describe an object in the room which has a square shape.
5. What is  a symbol of?

D. Evaluate what the students have learned from the film by checking the guide questions.

E. This film is about 15 minutes long and may be used as a band in a lesson.

PEGBOARD GEOMETRY

Teacher Commentary

I. Unit: Geometry

II. Objectives: Student should be able to:

A. Name and identify vertex

B. Construct quadrilaterals: including square, rectangle, parallelogram, and trapezoid, by using pegboard, pegs and rubber bands.

C. Distinguish among square, rectangle, trapezoid and parallelogram.

III. Materials:

A. Pegboard Geometry Kit including:

1. Pegboard
2. Pegboard Geometry Booklet on Quadrilaterals
3. Rubber bands
4. Pegs

B. Pencil

C. Crayons: red, blue

D. Ruler

E. Pattern I for pegboard

IV. Procedure:

A. This kit is designed for small group instruction and may be used to reteach material on quadrilaterals with students who are having difficulty. About six students should work the kit at a time. Students should be grouped in pairs, each pair should have a booklet, pegboard, pegs, rubber bands, and pattern.

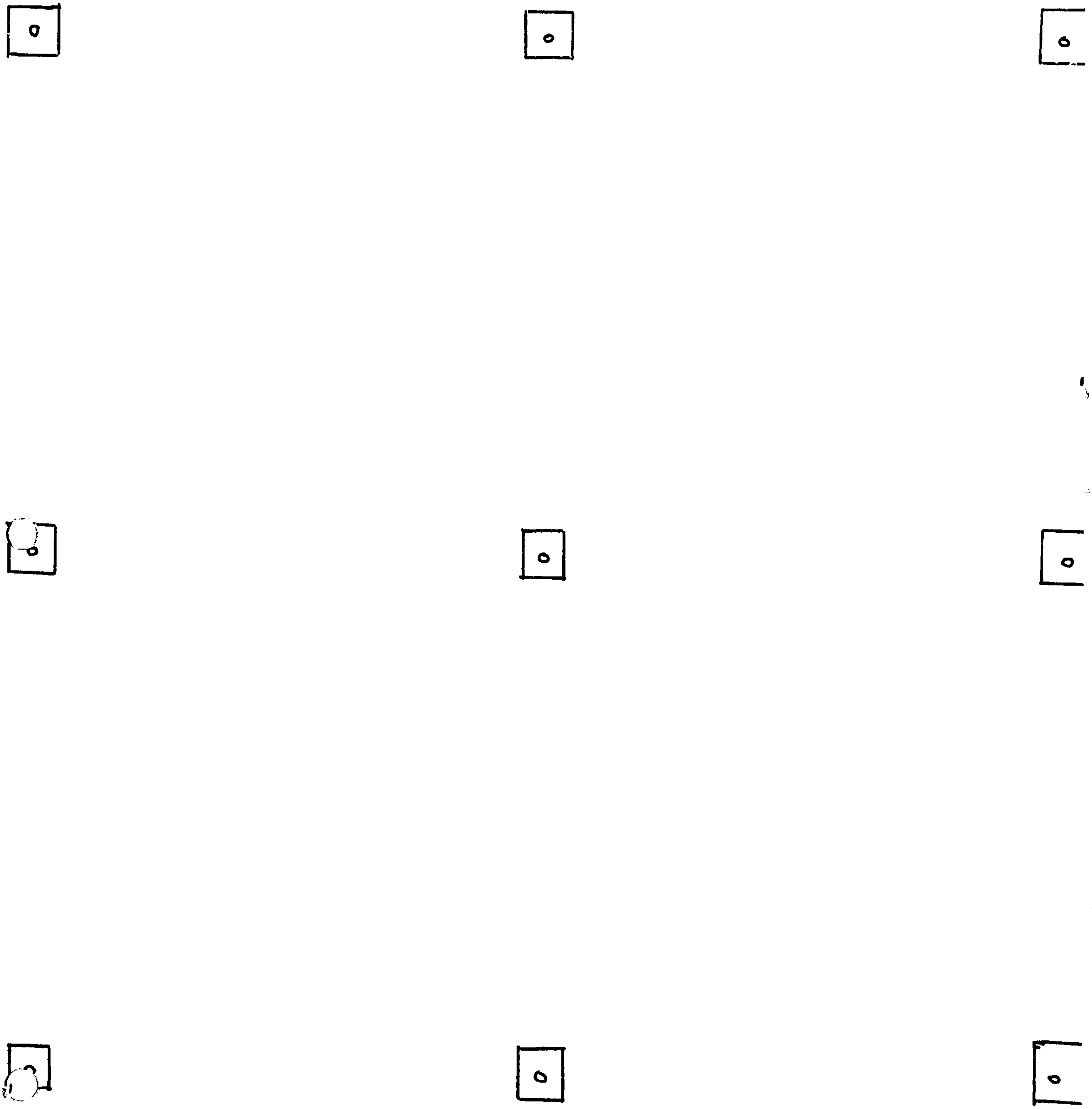
B. Permit each group to work through the booklet, each pair working at its own rate.

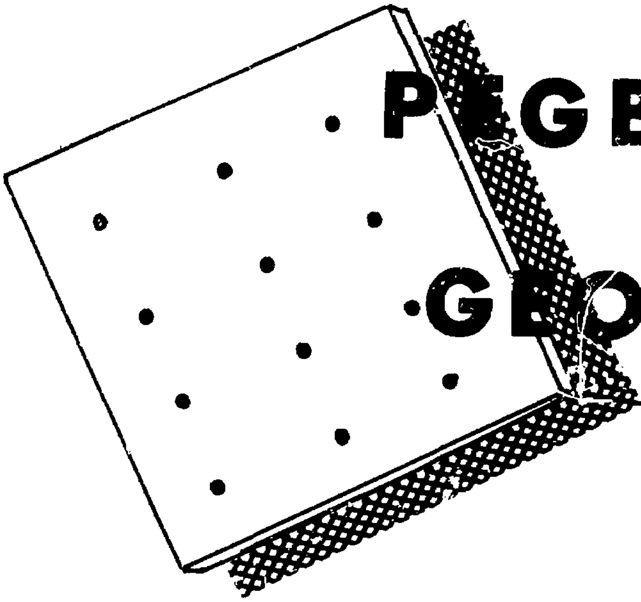
C. The last section of the booklet is an assessment activity.

Note: The pattern for placing pegs in holes on the pegboard is based on the following items which can be purchased from Lycetts, North Charles Street. Use the following specifications when ordering:

> Primary Pegboard #474X, Milton Bradley Company, Springfield, Massachusetts @ .90/board
>
> Pegs #472X or #475X, Milton Bradley Company @ .65/box of 100.

PATTERN I



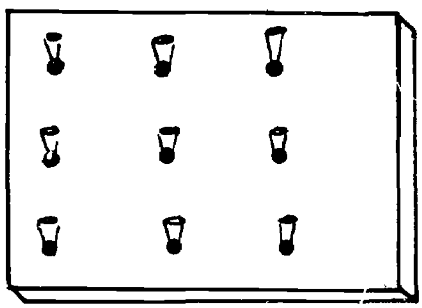


PEGBOARD GEOMETRY

QUADRILATERALS

Set up your pegboard in the following way:

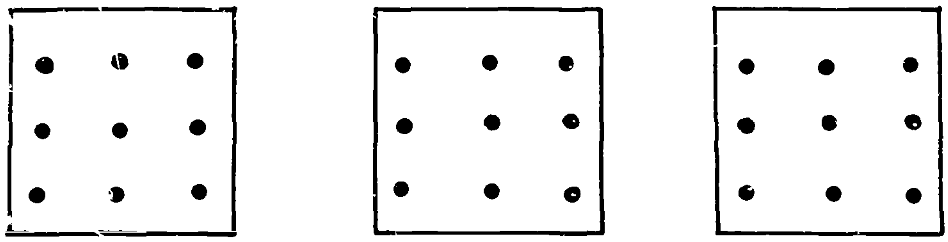
1. Place Pattern I on top of your pegboard
2. Put pegs through the holes as shown below:



Choose 4 rubber bands to put over the pegs to make 4-sided figures.

Remember: A simple closed path made up of 4 line segments is called a quadrilateral!

Make pictures of 3 of your quadrilaterals.



Look at your pictures of quadrilaterals.

Count the number of sides each quadrilateral has.

Each quadrilateral has __________ sides.

Look at your pictures of quadrilaterals again.

Count the number of corners each quadrilateral has.

Each corner is called a <u>vertex.</u>

The plural of vertex is <u>vertices.</u>

Each quadrilateral has __________ vertices.

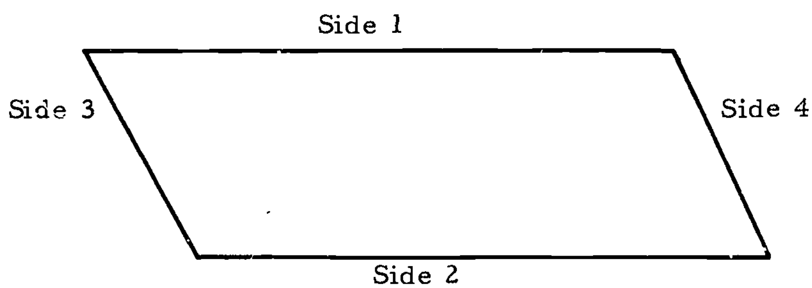
Some quadrilaterals have special names.

Let's see if we can review some of these names.

On your pegboard make some quadrilaterals whose opposite sides are equal and parallel.

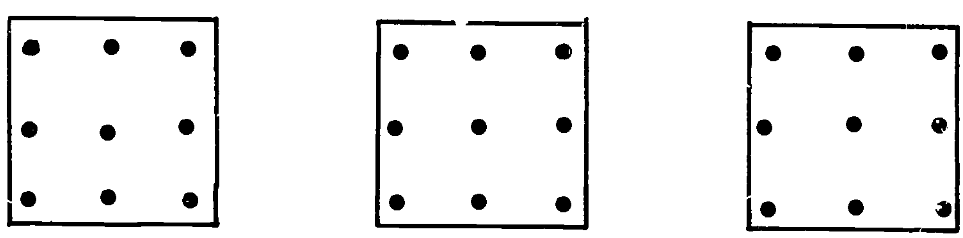
The drawing below may help you to think about what this means.

Sides 1 and 2 are equal and parallel.



Sides 3 and 4 are equal and parallel.

Make drawings of 3 of these quadrilaterals.

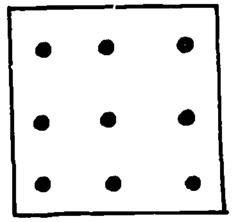


We call quadrilaterals like these whose opposite sides are equal and parallel, parallelograms.

Now look at your drawings of parallelograms.

Do any of the parallelograms have 4 square corners?

If so, draw it here.



If not, try to make one. Draw it here.

This type of parallelogram has a special name. Do you know what it is?

We call this type of parallelogram a rectangle.

A ______________ is a parallelogram with 4 square corners.

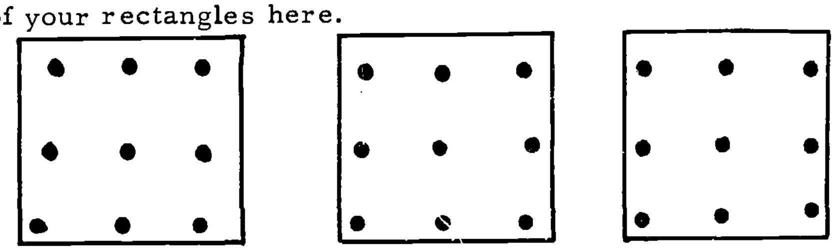
A ______________ is a quadrilateral that has opposite sides equal and parallel.

Now let's see how many different kinds of rectangles you can make on your pegboard.

Remember! A rectangle must have:

1. 4 square corners
2. opposite sides equal
3. opposite sides parallel

Draw pictures of your rectangles here.



Look at the rectangles you have drawn.

How many square corners do they have? ______________

Are the opposite sides equal? __________ Measure them on your board.

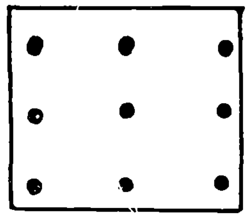
Are the opposite sides parallel? __________

There is 1 special kind of rectangle.

Look at your drawings of rectangles.

Do any of your rectangles have all four sides equal?

Draw it here.



Do you know the name of this type of rectangle.
We call this type of rectangle a square.

Look at your drawing of a square.

How long is each of its sides? ____________ Measure them.

How many vertices does your square have? ______________

parallelogram quadrilateral rectangle angle

A ___________________ is a rectangle with all sides equal.

A ___________________ is a parallelogram with 4 square corners.

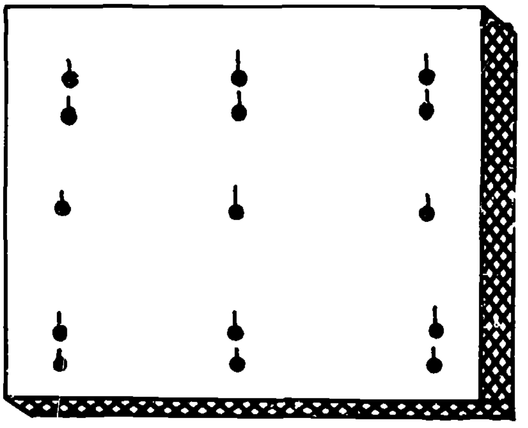
A ___________________ is a quadrilateral that has opposite sides equal and parallel.

A ___________________ is a simple closed path with four line segments for sides.

Now let's see if we can make another type of quadrilateral.

Place 6 more pegs in your pegboard. Put one peg in the hole below each peg in the top row. Put one peg in the hole above each peg in the bottom row.

Your pegboard should look like this:

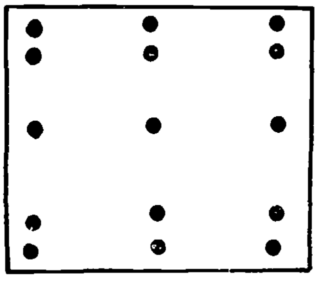


Let's see if you can make a quadrilateral that is:

a. not a parallelogram
b. not a rectangle
c. not a square

See if you can make a quadrilateral that has only 2 sides parallel.

Make a drawing of your quadrilateral here.



Check to see that:

1. 2 sides of this quadrilateral are parallel.
2. 2 sides of this quadrilateral are <u>not</u> parallel.

We call this type of quadrilateral a trapezoid.

Look at the trapezoids below.

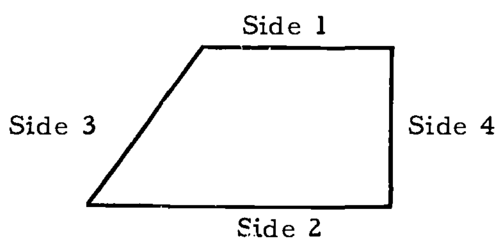
Name the vertices of these trapezoids M, N, P, and O.

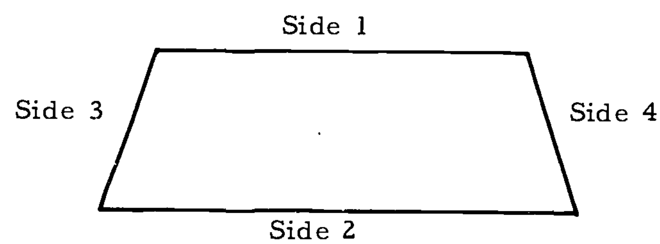
Which 2 sides of these trapezoids are not parallel? ________________

Which 2 sides of these trapezoids are parallel? ________________

Are the 2 sides of these trapezoids which are parallel also equal?

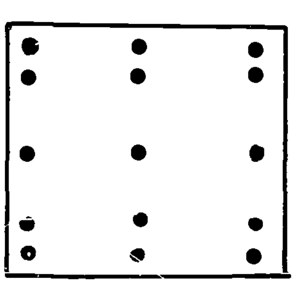
Yes ________ No ________

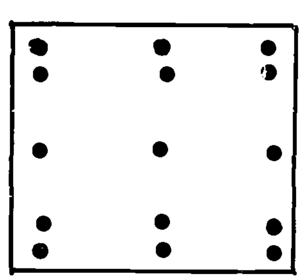


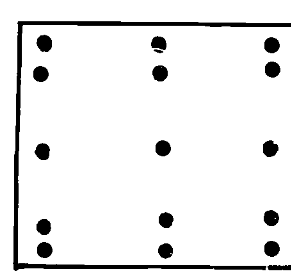


Make as many different trapezoids on your pegboard as you can.

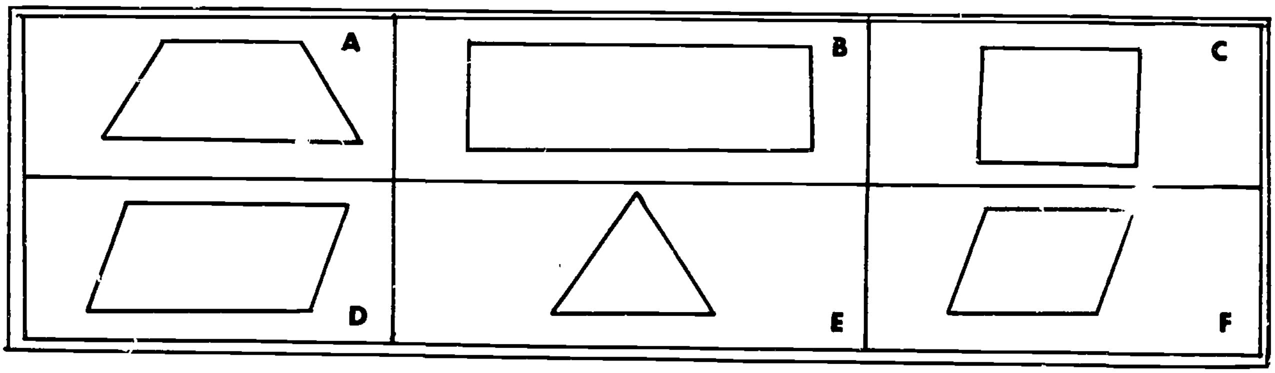
Draw 3 of them here.







Now let's see what you have learned.



1. Color the interior region of each parallelogram red.
2. Circle the letters of the rectangles.
3. Color the exterior region of the square blue.
4. Name the vertices of the trapezoid N, F, S, and G.

GEO-KIT

Teacher Commentary

I. Unit: Geometry

II. Objectives: The student should be able to:

A. Construct 5 basic geometric figures (parallelogram, rectangle, square, rhombus, trapezoid) using triangles

B. Describe properties associated with each figure

III. Materials:

A. One box for storing all materials

B. Each box should contain 5 sets of each of the following items:

1. Envelope 1 - 6 green equilateral triangles, 6 orange equilateral triangles

2. Envelope 2 - 5 yellow right triangles, 5 pink right triangles

3. Envelope 3 - 1 orange hexagon

4. Envelope 4 - 5 red right triangles, 5 blue right triangles

5. Envelope 5 - 5 green isosceles triangles

6. Envelope 6 - 10 metal rings

7. Set of 11 experiments (divided into 2 sets)

8. Pencil

9. Straightedge (tag board)

IV. Procedure:

A. The materials in this kit are designed as a culminating activity. Therefore, work with the kit should run concurrently with the unit on geometry.

B. The class should be divided into groups containing 1-5 students. Each student is to work at his own rate of speed. While a certain group is working with the geo-kit, other groups could work with related topics in geometry, practice fundamental operations, etc.

C. From the box each student should select:

   1. A complete set of envelopes

   2. Two sets of experiments

      a. Set 1 (Experiments 1-4)

      b. Set 2 (Experiments 5-11)

D. All answers should be placed on the experiment sheets.

E. Answer sheets should be collected at the end of each period.

F. The testing devices are built into the experiments.

SET I

grade 7

SHAPES WITH CARDS

EXPERIMENT 1, PART 1

Choose 2 triangles from envelope 1.

Make as many shapes as you can using these two triangles.

Draw these shapes below.

Choose the shape which has only 4 sides.

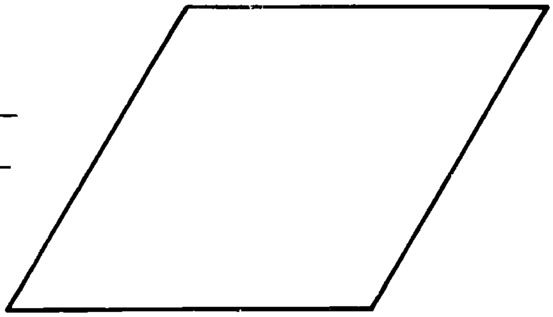
Are the sides equal? ______________

How do you know? ____________________________________

This shape is called a rhombus.

It has how many equal sides? ________________

EXPERIMENT 1, PART 2



What is this figure called? ____________

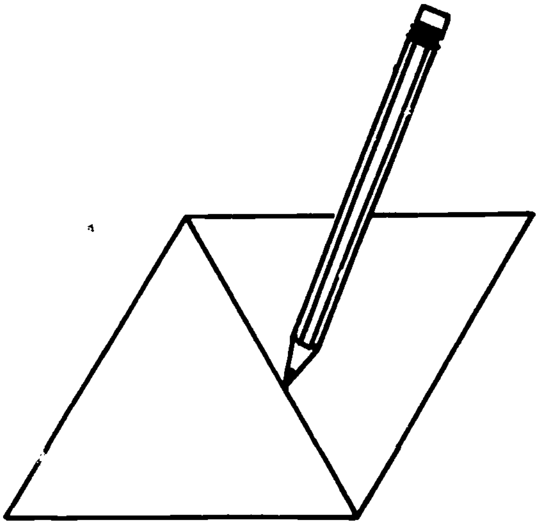
Are the sides equal? ________________

Try to p'̣ce 2 triangles from envelope 1 so they fit in the rhombus above.

Show how you place the triangles in the rhombus.

You can do this by tracing around the triangle.

Study the picture at the right.



PUT THE TRIANGLES BACK IN ENVELOPE 1

EXPERIMENT 1, PART 1

Choose 3 triangles from envelope 1.

Make as many shapes as you can using these three triangles.

Draw these shapes below.

Choose the shape which has only 4 sides.

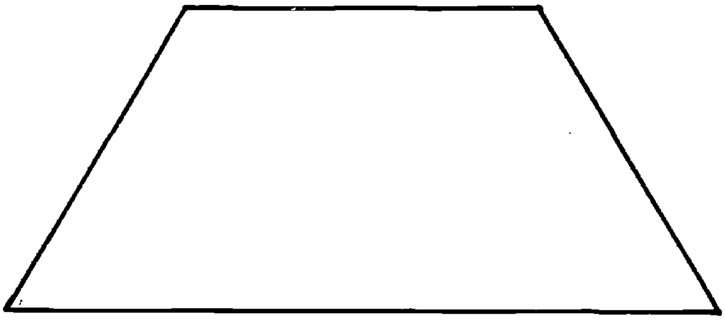
Are all four sides equal? ______________

Is there a pair of sides which are equal? ______________

How do you know? ______________________________

This 4-sided figure is called a trapezoid (Trap - e - zoid).

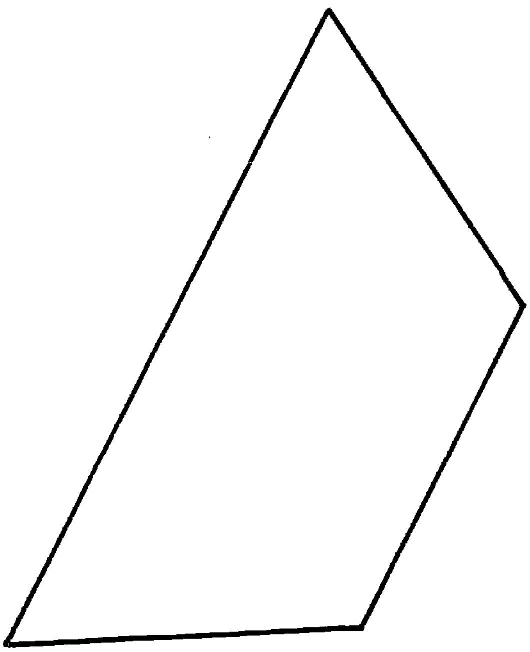
EXPERIMENT 2, PART 2



What are these shapes called? ____________________

How many sides does each shape have? ______________

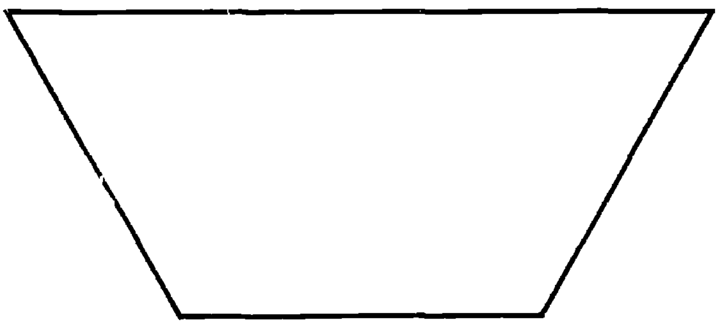
Are all sides equal? ________



Try to place 9 triangles from envelope 1 in the trapezoids.

How many triangles did you need for each trapezoid?

____



Show how you placed the triangles in the trapezoids.

REMEMBER! You can show this by tracing around each triangle.

PUT THE TRIANGLES BACK IN ENVELOPE 1

EXPERIMENT 3, PART 1

Choose 4 triangles from envelope 1.

Make as many shapes as you can using these 4 triangles.

Draw these shapes below.

Choose the shape which has only 4 sides.

How many pairs of equal sides are there? ____________________

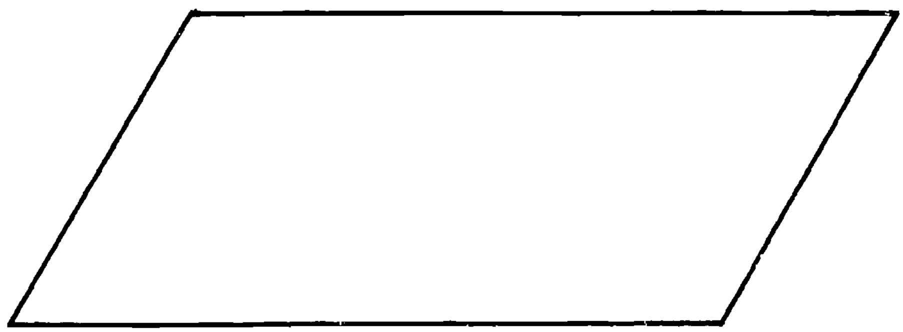
How do you know? ____

This 4-sided figure is called a parallelogram.

Is a parallelogram different from a trapezoid? _______________

In what way is it different? __________________________________

EXPERIMENT 3, PART 2



What is this figure called? ____________________

How many pairs of equal sides does this figure have? ____________________

Look at the top and bottom sides.

Are these sides parallel? ____________________

Look at the left and right sides.

Are these sides parallel? ____________________

How many pairs of parallel sides does a parallelogram have? __________

PUT THE TRIANGLES BACK IN ENVELOPE 1

EXPERIMENT 4, PART 1

Choose 6 triangles from envelope 1.

Make as many shapes as you can using the six triangles.

Draw these shapes below.

Did you make any 4-sided figures? ________ If you didn't, try to do so.

Did you make any parallelograms? ________ If you didn't, try to do so.

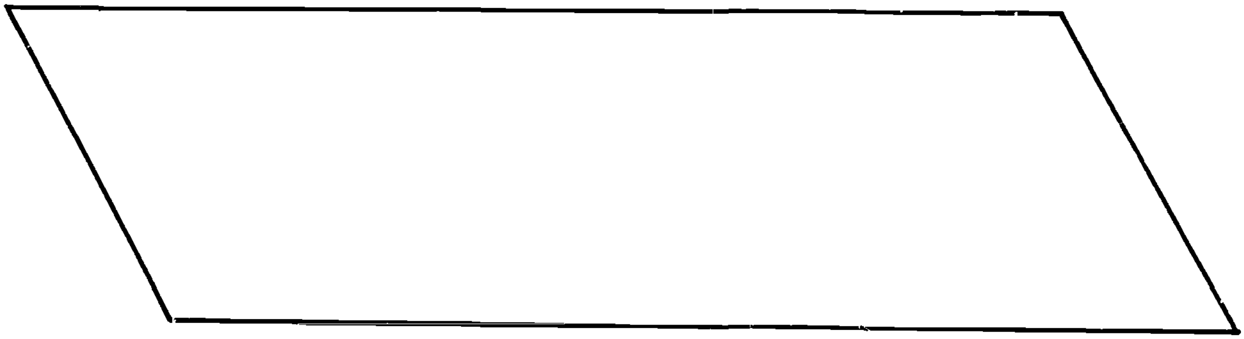
Does a parallelogram have 2 pairs of equal sides? ________________

How do you know? ____

Does a parallelogram have 2 pairs of parallel sides? ______________

How do you know? ____

EXPERIMENT 4, PART 2



What is this figure called? ________________________

Try to place 6 triangles from envelope 1 in the parallelogram.

How many did you need? ________________

Show how you placed the triangles in the parallelogram.

REMEMBER! You can show this by tracing around each triangle.

A parallelogram has __________ pairs of equal sides.

A parallelogram has __________ pairs of parallel sides.

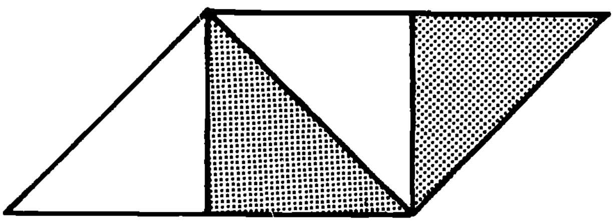
Place an X on one pair of parallel sides.

Place a on the other pair of parallel sides.

PUT THE TRIANGLES BACK IN ENVELOPE 1

SET II

grade 7



SHAPES WITH CARDS

EXPERIMENT 5, PART 1

Choose 2 triangles from envelope 2.

Does 1 of these triangles have any equal sides? ________

If so, how many? ________________

Each of these triangles has one right angle.

Can you find it? It is opposite the longest side.

Make as many shapes as you can using these two triangles.

Draw these shapes below.

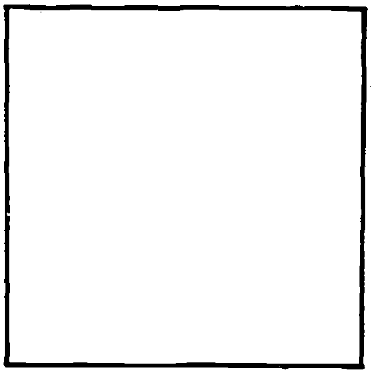
Choose the shape which has 4 sides, all equal.

How do you know the sides are equal? ______________________________

Are the sides parallel to each other? ________________

This figure is called a square.

EXPERIMENT 5, PART 2



What is this figure called?

____

Does it have any equal sides?

____

If so, how many? ____________

Try to place 2 triangles from envelope 2 in the square.

Find all the right angles in the square.

How many are there? ________________

Show your choices by placing an X inside each right angle.

PUT THE TRIANGLES BACK IN ENVELOPE 2

EXPERIMENT 6, PART 1

Choose 4 triangles from envelope 2.

Make as many shapes as you can using these 4 triangles.

Draw these shapes below.

You could have formed four 4-sided figures.

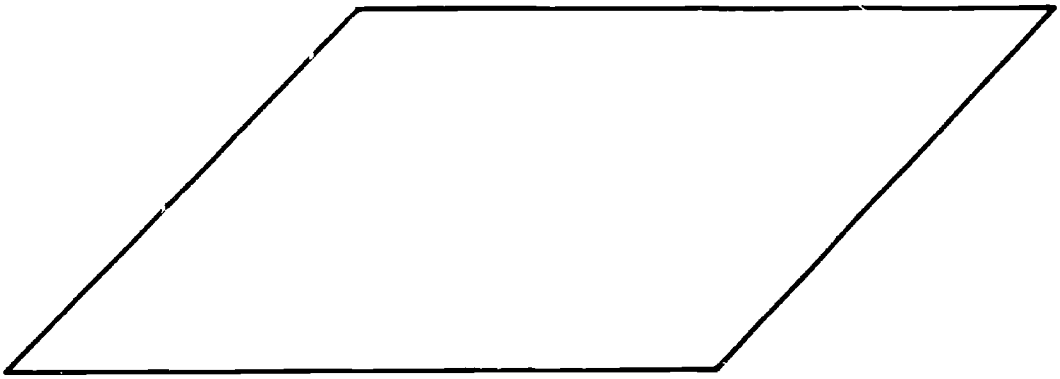
2.3

EXPERIMENT 6, PART 2

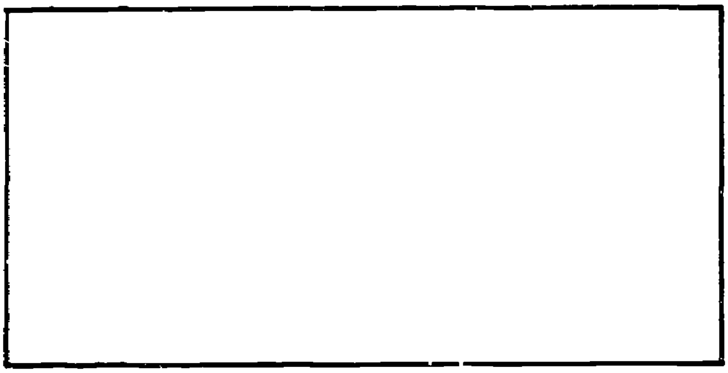
Try to place triangles from envelope 2 in the figures below.

Show how you placed the triangles in each of the four sided figures.

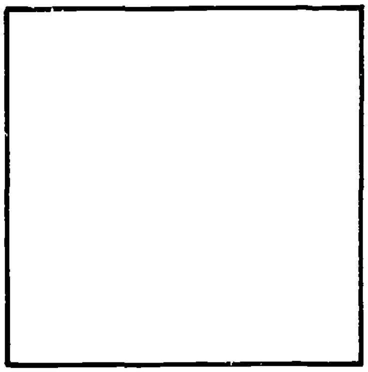
You can show this by tracing around each triangle.



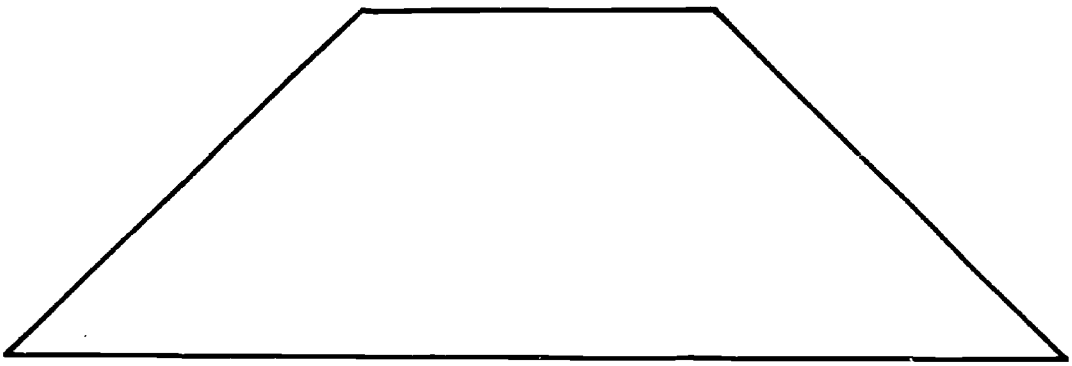
A



B

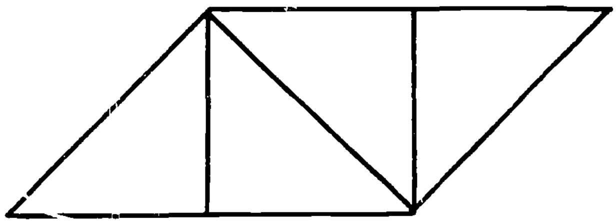


C

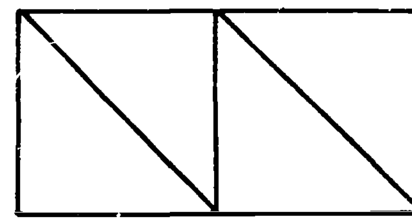


D

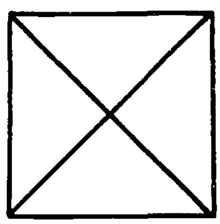
EXPERIMENT 6, PART 3



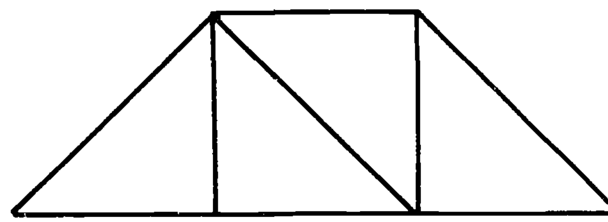
A



B



C



D

These drawings are a copy of what you did in experiment 6, part 2. Use them to answer the following questions.

Which figures have 2 pairs of equal sides? ____________________

Which figures have 2 pairs of parallel sides? ____________________

These figures are called parallelograms.

A parallelogram has ________ pairs of equal sides and ________ pairs of parallel sides.

Which figures have 4 right angles? ____________________

These figures are called rectangles.

A rectangle is a parallelogram with ________ right angles.

Which figure has 4 equal sides? ______________

This figure is called a square.

A square is a parallelogram with ________ right angles and ________ equal sides.

Can you identify figure D? ________________

This figure is called a trapezoid.

It has only 1 pair of parallel sides.

PUT THE TRIANGLES BACK IN ENVELOPE 2

EXPERIMENT 7

Choose 8 triangles from envelope 2.

Try to place triangles from envelope 2 in this square. Show how you place the triangles in the square. You can show this by tracing around each triangle.

How many squares of this size are in the large square? ______

How many triangles of this size are there in the square?

______

How many rectangles of this size are in the large square? (Do not count any squares.) ______

How many triangles of this size are there in the square? ______

PUT THE TRIANGLES BACK IN ENVELOPE 2

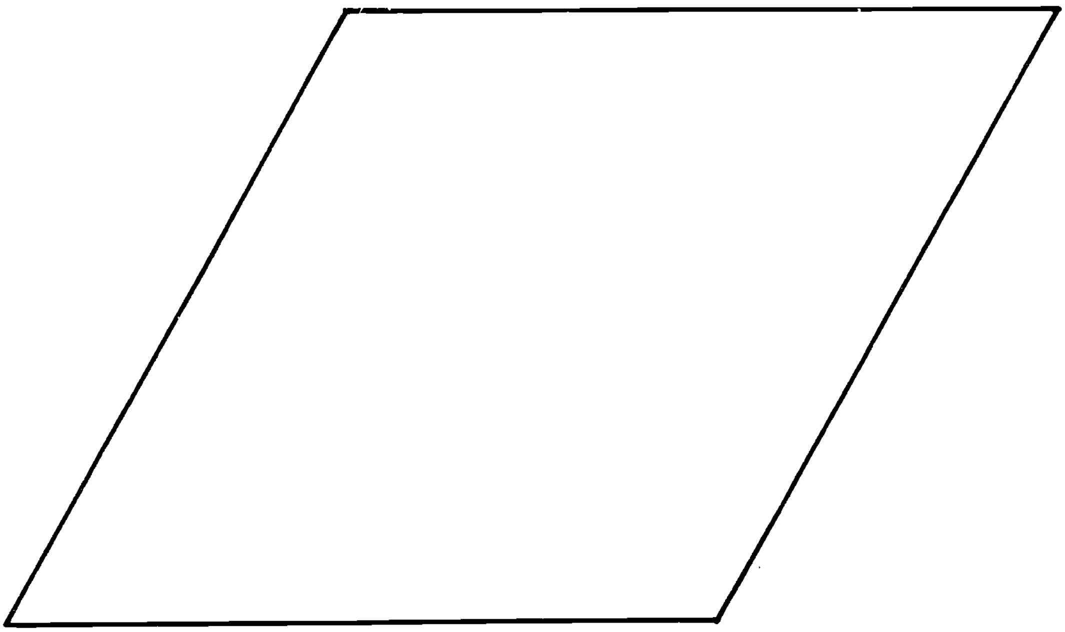
EXPERIMENT 8, PART 1

Choose 4 triangles from envelope 4.

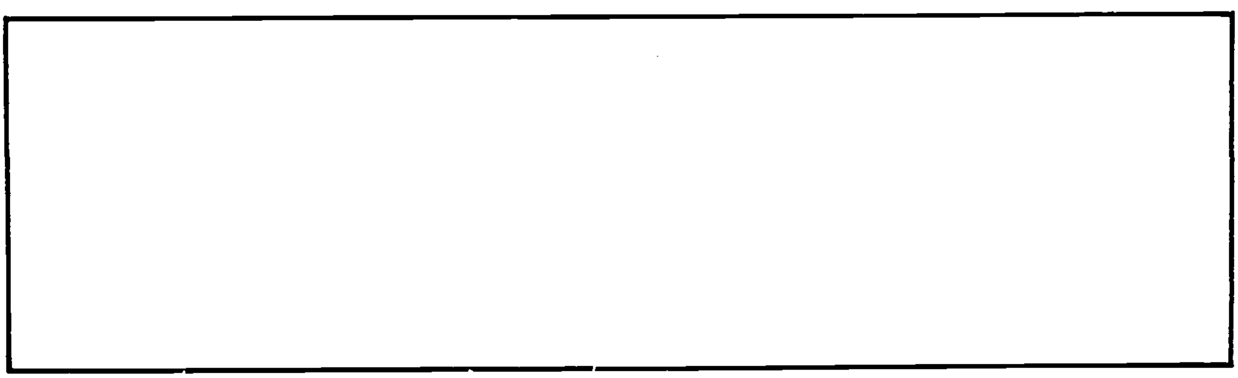
Try to place the 4 triangles in each shape below.

Show how you placed the triangles in each figure.

You can do this by tracing around each triangle.



A



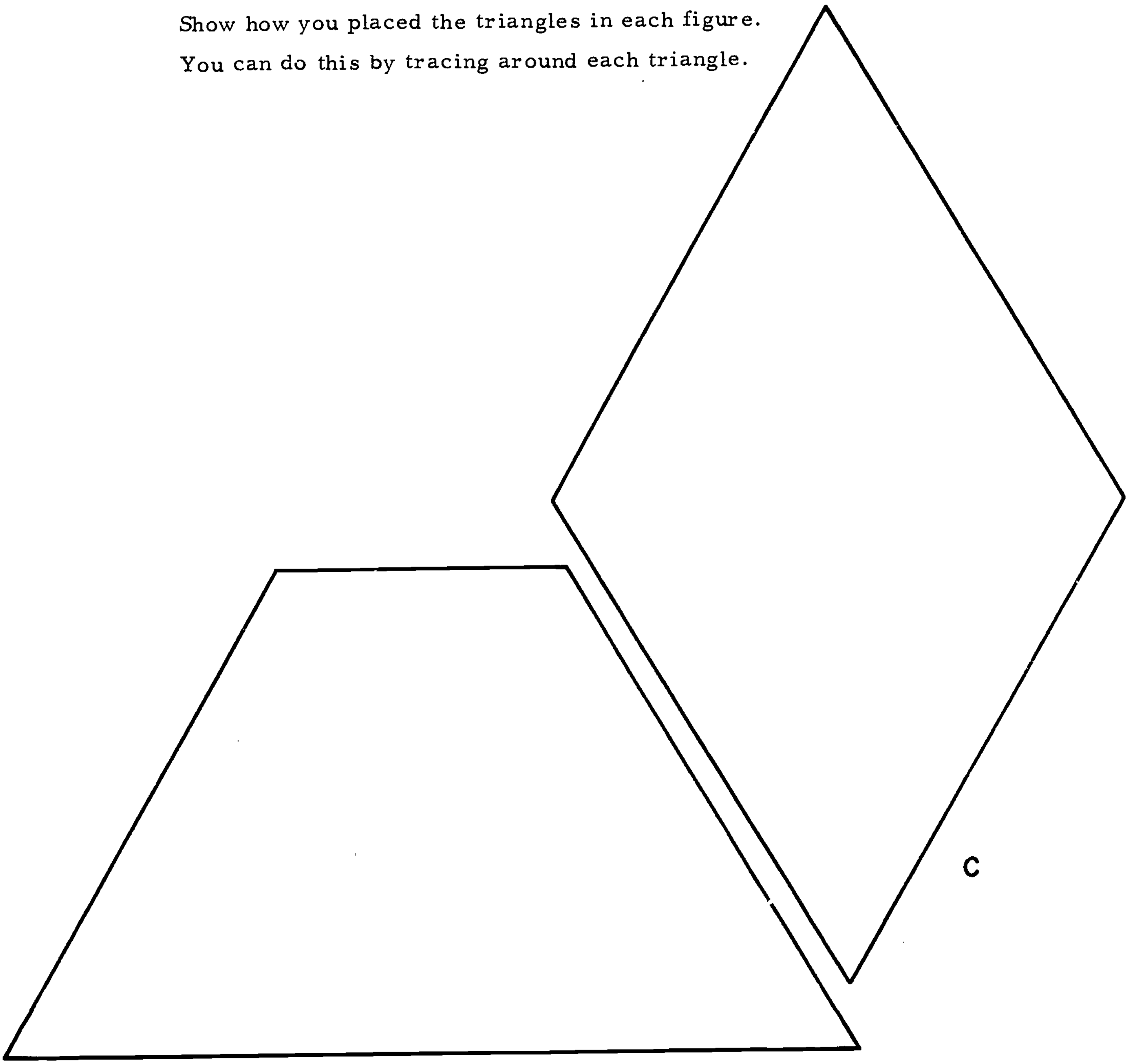
B

EXPERIMENT 8, PART 2

Try to place the 4 triangles from envelope 4 in each shape below.

Show how you placed the triangles in each figure.

You can do this by tracing around each triangle.



C

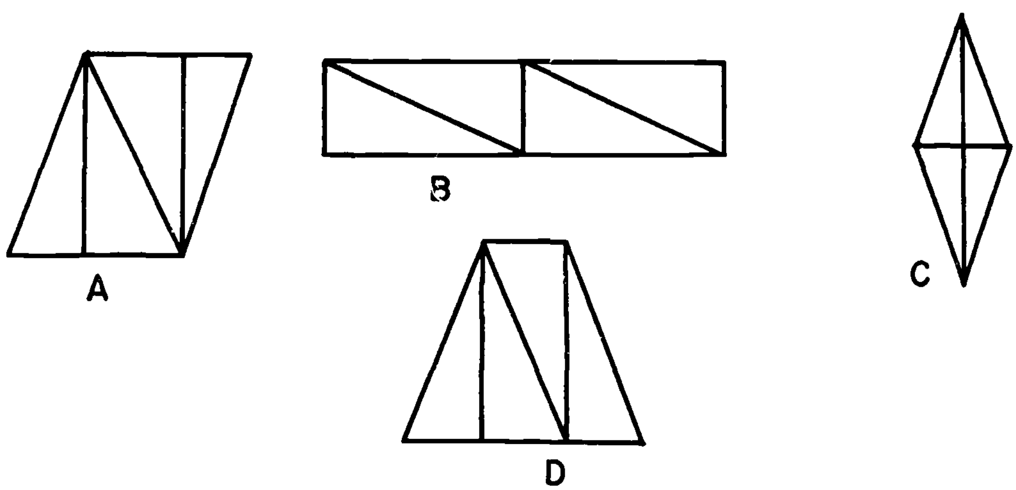
D

PUT THE TRIANGLES BACK IN ENVELOPE 4

EXPERIMENT 8, PART 3

These drawings are a copy of what you did in experiment 8, parts 1 and 2.

Use the drawings to help you answer the following questions.



Look at figure A.

How many pairs of equal sides does it have? ____________

How many pairs of parallel sides does it have? __________

This figure is called a ________________.

A parallelogram has _________ pairs of equal sides and _________ pairs of parallel sides.

Look at figure B.

How many pairs of equal sides does it have? ____________

How many pairs of parallel sides does it have? __________

Does it have any right angles? __________ If so, how many? ________

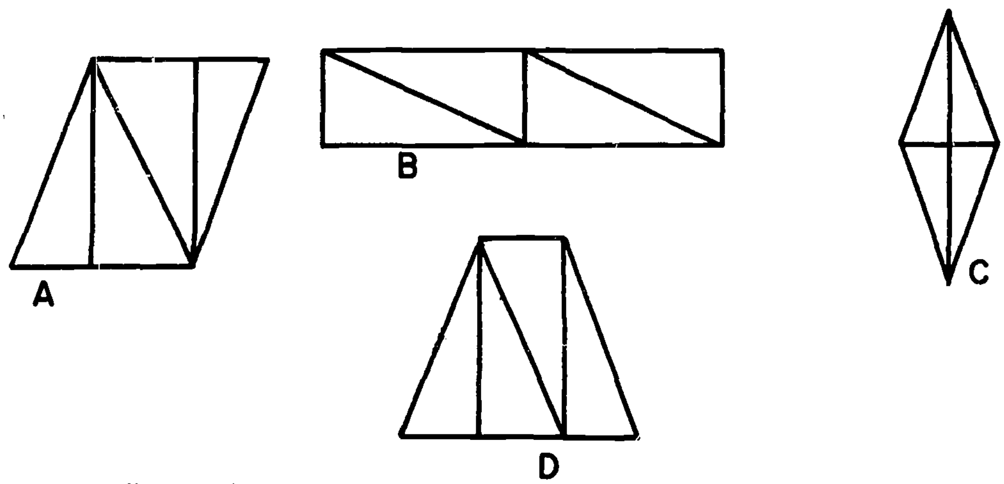
This figure is called a ________________.

A rectangle is a parallelogram with ____________ right angles.

EXPERIMENT 8, PART 4

These drawings are copy of what you did in experiment 8, parts 1 and 2.

Use the drawings to help you answer the following questions.



Look at figure C.

How many pairs of equal sides does it have? ____________

Does it have 4 equal sides? ________

How do you know? ____________________________

How many pairs of parallel sides does it have? __________

Does it have any right angles? ________

This figure is called a ______________.

A rhombus is a parallelogram with ________ equal sides.

Look at figure D.

How many pairs of equal sides does it have? ____________

How many pairs of parallel sides does it have? ____________

Does it have 4 equal sides? ________

Does it have any right angles? ______

This figure is called a ______________.

A trapezoid is a figure with _____ pair of parallel sides.

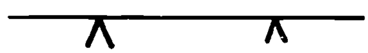
EXPERIMENT 9

Choose 4 circles from envelope 6.

Place 2 of the circles side by side on the line.

The edge of each circle should touch the line at the arrow.

Place the other 2 circles directly above the first 2 circles.



Do the circles suggest a 4-sided shape? ____________

Draw an outline of the shape.

What is this shape called? ________________________

Check the items which describe a square.

a. 4 equal sides _________

b. opposite sides are parallel ___

c. opposite sides are equal _______

d. 4 right angles _______

A square is a parallelogram with _______ equal sides and _______ right angles.

PUT THE CIRCLES BACK IN ENVELOPE 6

EXPERIMENT 10

Choose 4 circles from envelope 6.

Place 1 circle on the dot.

The edge of the circle should touch the dot.

Place 2 circles side by side above the first circle.

Each circle should touch the first circle.

Place the last circle above the second row of circles.

It should touch the 2 circles.

•

Do the circles suggest a shape? ____________

Draw an outline of this shape.

Does this shape have its opposite sides equal? ____________

Does this shape have its opposite sides parallel? __________

Does it have 4 equal sides? _____________

Does it have 4 right angles? ____________

What is this shape called? ______________

A <u>rhombus</u> is a <u>parallelogram</u> with __________ equal sides.

PUT THE CIRCLES BACK IN ENVELOPE 6

EXPERIMENT 11

Choose 6 circles from envelope 6.

Place 3 of the circles side by side on the line.
The edge of each circle should touch the line
at the arrow.
Place the last 3 circles above the first row
of circles.
Each circle should touch 1 circle on the first row.

What shape is suggested by the circles? ____________________

Draw an outline of this shape.

The shape has ________ pairs of parallel sides, ________ pairs of equal sides and ________ right angles.

This figure is called a ____________________

A rectangle is a parallelogram with ________ right angles.

PUT THE CIRCLES BACK IN ENVELOPE 6

GEOMETRY: CURVES AND CIRCLES

Teacher Commentary for Film

I. Unit: Geometry

II. Objectives: The student should be able to:

A. Name and identify

1. Closed path (curve)
2. Line segment
3. Circle

B. Describe in terms of its surroundings:

1. Closed path (curve)
2. Line segment

C. Describe a circle in terms of all points on the circle being the same distance from the center

III. Materials: Motion picture film - <u>Geometry</u>: <u>Curves</u> <u>and</u> <u>Circles.</u> Film Associates; Baltimore County Central Film Library No. 354

IV. Procedure:

A. Use as a review of closed paths, line segments, and circles.

B. Motivate the students immediately before showing the film.

C. This film is about 15 minutes long and should be used as one band in a lesson.

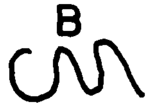
D. List the following guide questions on the board to insure that the students know the reason for viewing the film.

Examples:

1. What is an open curve?
2. Describe a closed curve.
3. Which of the following symbols represents a line segment?

A

B



MEASUREMENT

MEASUREMENT

UNIT MEASUREMENT GRADE(S) Seven through Nine

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Area	7	7	7			7				
Square Inch	7	7		7	7	7				
Square Foot	7	7		7	7	7	7			
Square Yard	7	7		7	7	7	7			
Area of Square	7	7	7	7		7	7	7		7
Area of Rectangle	7	7	7	7		7	7	7		7
Area of Triangle	8	8	8		8	8	8			8
Area of Parallelogram	8	8	8		8	8	8			8
Area of Circle	8	8	8		8	8	8			8
Area of Other Polygons			9		9	9	9	9		
Acre	9	9	9		9	9				
Surface Area	9	9	9			9				
Total Surface Area of Cube	9	9			9	9	9			
Lateral Surface Area of Cube	9	9			9	9	9			
Total Surface Area of Box	9	9	9			9	9			
Lateral Surface Area of Box	9	9	9			9	9			
Total Surface Area of Cylinder	9	9	9			9	9			
Lateral Surface Area of Cylinder	9	9	9			9	9			

UNIT MEASUREMENT GRADE(S) Six through Nine

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Inch	6	6	6	6	6	6	6		6	
1/2 Inch	6	6	6	6	6		6		6	
1/4 Inch	7	7	7	7					7	
1/8 Inch	8	8	8							8
1/16 Inch	9	9	9							9
Foot	6	6	6	6	6	6	6		6	
Yard	6	6	6	6	6	6	6		6	8
Meter	8	8	8	8	8				8	8
Centimeter	8	8	8			8	8		8	9
Millimeter	9	9	9			9	9		9	9
Mile	7	7				7	7			
Perimeter	7	7	7			7	7			
Perimeter Square	7	7	7	7		7	7	7		
Perimeter Triangle	7	7	7	7		7	7	7		
Perimeter Rectangle	7	7	7	7		7	7	7		
Perimeter Polygons			8	8		8	8	8		
Circumference	8	8	8			8				
Pi	8	8			8	8	8			

UNIT MEASUREMENT GRADE(S) Six through Ten

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Micrometer	10	10	10							
Caliper	10	10	10							
Volume	10	10	10			10				
Cubic Inch	10	10		10	10					
Cubic Foot	10	10		10	10	10	10			
Cubic Yard	10	10		10	10	10	10			
Volume of Cube	10	10	10			10	10	10		
Volume of Rectangular Solid	10	10	10			10	10	10		
Volume of Cylinder	10	10	10			10	10	10		
Angular Measurement	9	9				9				
Degree	9	9			9	9	9	9		
Protractor	9	9	9	9	9	9	9	9		
Central Angle	10	10	10	10		10	10			10
Inscribed Angle	10	10	10	10		10	10			10
Corresponding Angles	10	10		10		10	10	10		
Ounce	6	6	6			6	6	6	6	
Pound	6	6	6			6	6	6	6	
Pint	6	6	6			6	6	6	6	

UNIT **MEASUREMENT** GRADE(S) Six through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Quart	6	6	6			6	6	6	6	
Fluid Ounce	10	10	10			10	10	10	10	
Gallon	6	6	6			6	6	6	6	
Cup	10	10	10			10	10	10	10	
Degree Fahrinheit	6	6	6			6	6	6	6	
Degree Centigrade	7	7	7			7	7	7	7	
Similar Triangles (Ratio, Proportion)	10	10	10		10	10	10	10		
Scale Drawing			10	10	10	10		10		
Trig Tables	11	11		11	11					
Pythagorean	10	10	10			10	10	10		

UNIT MEASUREMENT GRADE(S) Seven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
1/4 inch	7	7	7	7						
Mile	7	7				7	7			
Perimeter	7	7	7			7	7			
Perimeter Square	7	7	7	7		7	7	7		
Perimeter Triangle	7	7	7			7	7	7		
Perimeter Rectangle	7	7	7	7		7	7	7		
Area	7	7	7			7				
Square Inch	7	7		7	7	7				
Square Foot	7	7		7	7	7	7			
Square Yard	7	7		7	7					
Area of Square	7	7	7	7		7	7	7		7
Area of Rectangle	7	7	7	7		7	7	7		7
Degree Centigrade	7	7	7			7	7	7	7	

MEASUREMENT - Grade 7

Page

$\frac{1}{4}$ Inch

The student should be able to:

1. Nar and identify the $\frac{1}{4}$ inch
2. Demonstrate how to measure something to the nearest $\frac{1}{4}$ inch
3. Construct a drawing of a $\frac{1}{4}$ inch using a ruler or freehand sketch

Mile

The student should be able to:

1. Name the unit of length called the mile
2. Identify the distance which approximates the mile by comparing known points of reference
3. State the principle: 5, 280 feet = 1 mile (approximately 12 city blocks = 1 mile)
4. Apply the principle by converting from miles to feet and approximating from feet to miles

Perimeter

The student should be able to:

1. Name and identify the perimeter of a figure as the distance around it M-17
2. Demonstrate how to measure the perimeter of familiar objects in the classroom M-21
3. State the principle that the perimeter is the sum of the lengths of the sides of the figure
4. Apply the principle to find perimeter

Perimeter: Square, Triangle, Rectangle

Page

M-11
M-12
M-15
M-16
M-18

The student should be able to:

1. Name and identify the perimeter of a square, triangle, and rectangle

2. Demonstrate how to find the perimeter of these figures by measuring

3. Construct drawings of squares and rectangles, given their perimeters

4. State the principles:

   a. Perimeter of a square, $p = 4s$

   b. Perimeter of a triangle, $p = a + b + c$

   c. Perimeter of a rectangle, $p = 2(l + w)$ or $2l + 2w$

5. Apply these principles by finding the perimeters of various squares, triangles, and rectangles, given their dimensions

6. Interpret these principles by solving related problems

Area

The student should be able to:

1. Name and identify the area of a figure as a measure of its interior

2. Demonstrate how to measure the area by using various regions

3. State the principle that the area of a figure is the number of regions which cover the surface

Square Inch, Square Foot, Square Yard

The student should be able to:

1. Name and identify the square units of measure: square inch, square foot, square yard

2. Construct a model of a square unit of measure by drawing or cutting each from paper

3. Describe each unit in terms of surroundings or the definition a square inch is a square whose measure is one inch on a side

4. State the principles:

   a. 1 square foot = 144 square inches

   b. 1 square yard = 9 square feet

5. Apply the principle by con·-erting square feet to square yards and square yards to square feet

Area of Squares and Rectangles

The student should be able to:

1. Name and identify the area of a square and a rectangle
2. Demonstrate how to measure the area by using the standard square units M-20 M-21
3. Construct drawings of figures given their areas
4. State the principles: the area of a rectangle and a square is equal to the length times the width
5. Apply the principle by finding the area of various figures, given their dimensions
6. Interpret the principles by solving related problems
7. Distinguish between the area of a square and rectangle: e.g., the area of a square = s x s, area of a rectangle = l x w

Degree (Centigrade)

The student should be able to:

1. Name and identify the basic unit, degree, on the centigrade scale
2. Demonstrate how to measure the temperature with a centigrade thermometer
3. State the principles: e.g., temperature is a number which measures heat, boiling point of water 100°, freezing point of water 0°
4. Apply and interpret the principles to solve related problems
5. Order the degrees of temperature from hottest indication to coldest indication or vice versa

HISTORY OF MEASUREMENT

Teacher Commentary

I. Unit: Measurement

II. Materials:

A. Tape "History of Measurement"

B. Work sheet "Early Measures"

C. Tape recorder

D. Listening posts

E. Filmstrip "The Story of Weights and Measures"

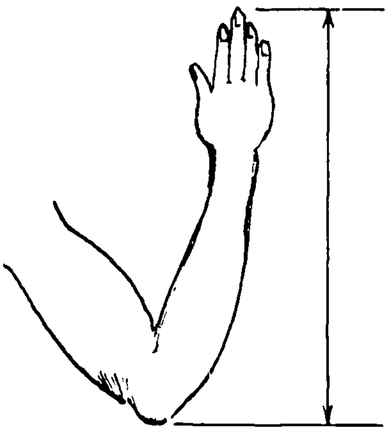
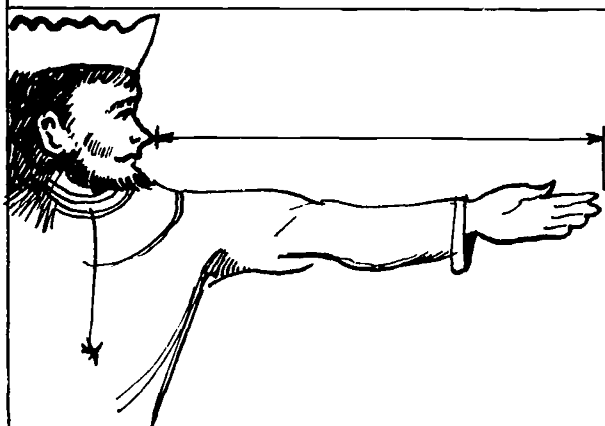
F. Filmstrip projector

III. Procedure:

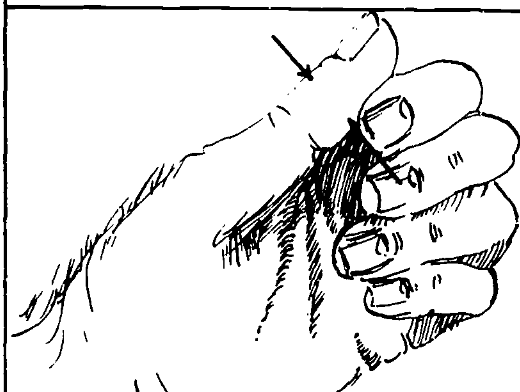
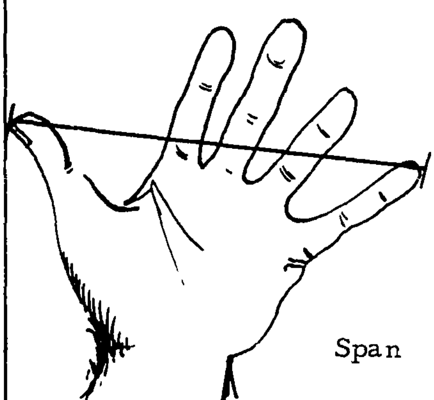
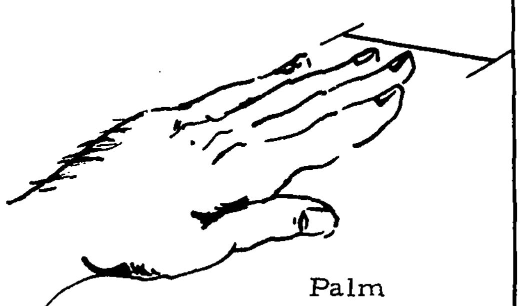
For those students who have completed one booklet and do not need help in another area of measurement, use the tape-filmstrip presentation "History of Measurement."

1. The tape recorder, filmstrip, and listening posts should be set up ahead of time. Be sure the filmstrip is on the beginning frame and the tape is advanced to the correct beginning point.
2. One student should be selected to turn off the tape recorder and one should be selected to advance the frame on the projector.
3. Work sheet, "Early Measures," should be distributed.
4. Make certain each student has a pencil.
5. If necessary, explain the use of the headsets.
6. The tape may then be turned on and the students permitted to work through the materials.

EARLY MEASURES

Early Measure	Your Measure	Standard Measure
 Cubit		18-19 inches
 Foot		12 inches
 Yard		36 inches

EARLY MEASURES

Early Measure	Your Measure	Standard Measure
 Roman Inch Width of Thumb		
 Span		
 Palm		About $2\frac{3}{4}$ inches

PERIMETER - INVENTORY TEST

Teacher Commentary

I. Unit: Measurement

II. Objectives: The student should be able to:

Apply and interpret the principles concerning perimeter of a square, triangle, and rectangle

III. Materials: Inventory Test

IV. Procedure:

A. Distribute inventory tests on perimeter.

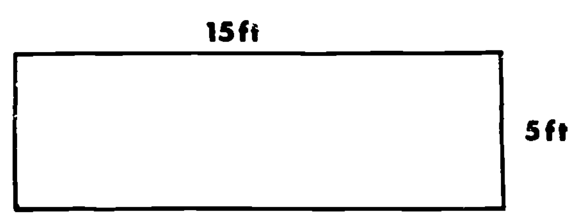
B. Read over the test with students, making certain they do not need help with any words.

C. Permit students to work problems.

D. Go over test with students.

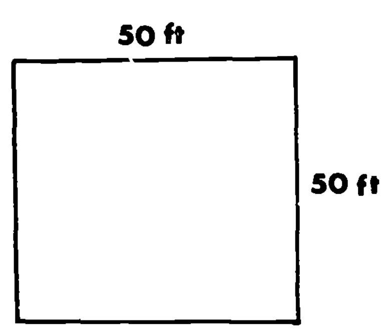
E. Solutions:

1. a.



b. 40 ft.

2. a.



b. 200 ft.

3. 128 ft. 4. 64 in. 5. 16 ft. 6. 16 ft.

PERIMETER - INVENTORY TEST

1. Bob wanted to build a dog run for his dog. He plans to make it 15 feet long and 5 feet wide.
   a. Make a drawing to show what the pen might look like. Label the dimensions.

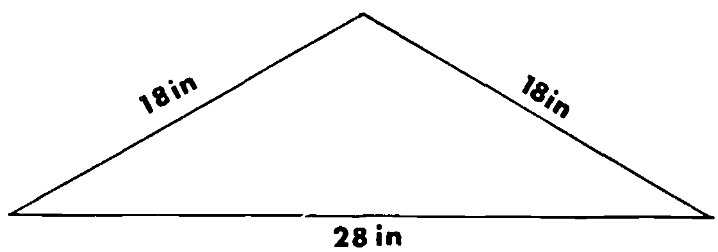
   b. Bob needs to buy fencing for the pen. How many feet of fencing does he need?

2. Joe's backyard measures 50 feet by 50 feet.
   a. Make a drawing to show how his backyard might look. Label the dimensions

   b. Find the perimeter of Joe's backyard.

3. Bill was asked to mark off a badminton court in the gym. The dimensions of the court were 20 feet by 44 feet. How many feet of tape does he need to mark off this court.

4. Carol wanted to put some braid around the scarf below. How much braid does she need?



5. Find the perimeter of a rectangle with these dimensions: 3 feet by 5 feet.

6. Find the perimeter of a square whose sides measure 4 feet.

PERIMETER - SQUARE - TRIANGLE

Teacher Commentary

Unit: Measurement

II. Objectives: The student should be able to:

A. Name and identify the perimeter of a square and a triangle

B. Demonstrate how to find the perimeter of these figures by measuring

C. Construct drawings of [illegible]res given their perimeters

D. State the principles: Perimeter of a square = 4 x s; Perimeter of a triangle = side a + side b + side c

E. Apply and interpret these principles

III. Materials:

A. Work sheet "Perimeter - Triangles"

B. Rulers

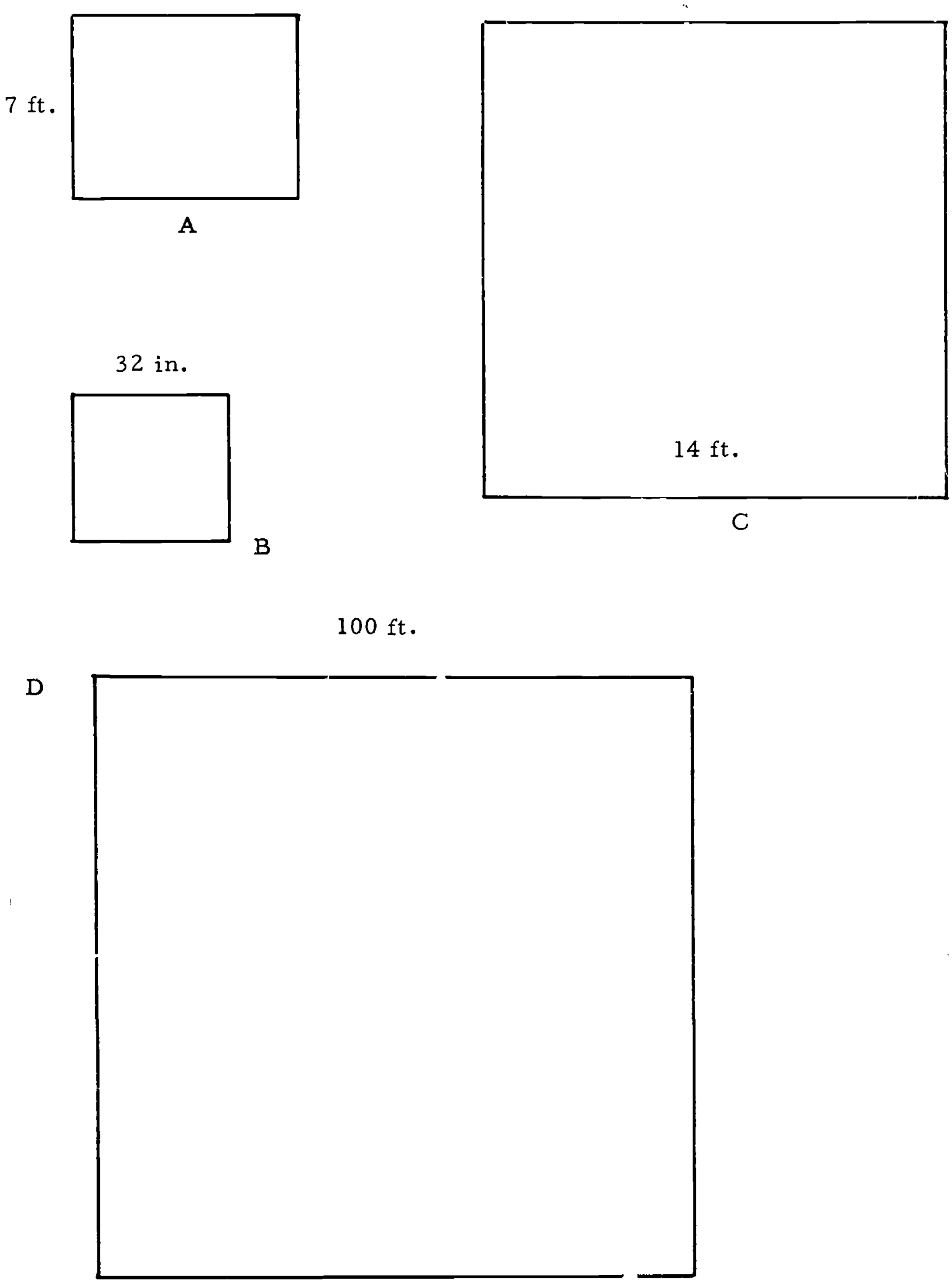
IV. Procedure:

A. Review finding the perimeter of a rectangle.

B. Present the student with a drawing similar to the one at the right.

Ask what is special about this rectangle? How can we find its perimeter? See if students can discover the short cut, i.e. $P = 4s$.

C. Use drawings of the following squares on the board and have students find the perimeter of each.



D. Draw and label the square whose perimeter is:

1. 20 inches

2. 8 feet

3. 36 inches

E. Distribute the work sheet entitled, "Perimeter - Triangles I"

1. Have students measure the sides of each triangle in Part I.

2. Have students find the perimeter of each.

3. Discuss the perimeter of each and how they obtained it.

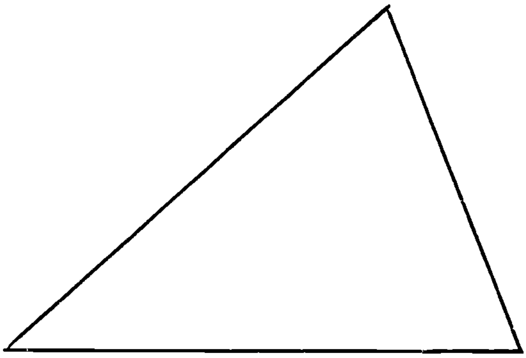
4. Develop the formula that the perimeter of a triangle = side a + side b + side c, i. e. $P = a + b + c$.

5. Find the perimeter of each triangle in Part II of work sheet.

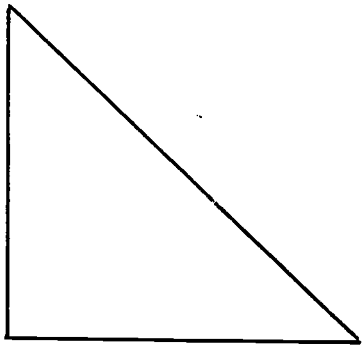
F. Summari ·e by having the students restate the formulas for finding the perimeters of rectangles, squares, and triangles.

PERIMETER - TRIANGLES

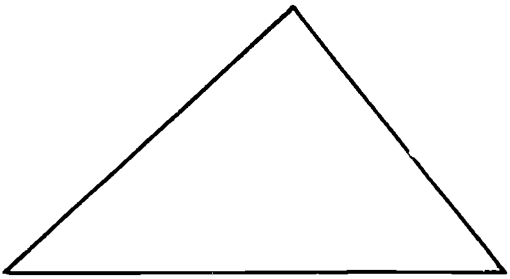
Part I



A

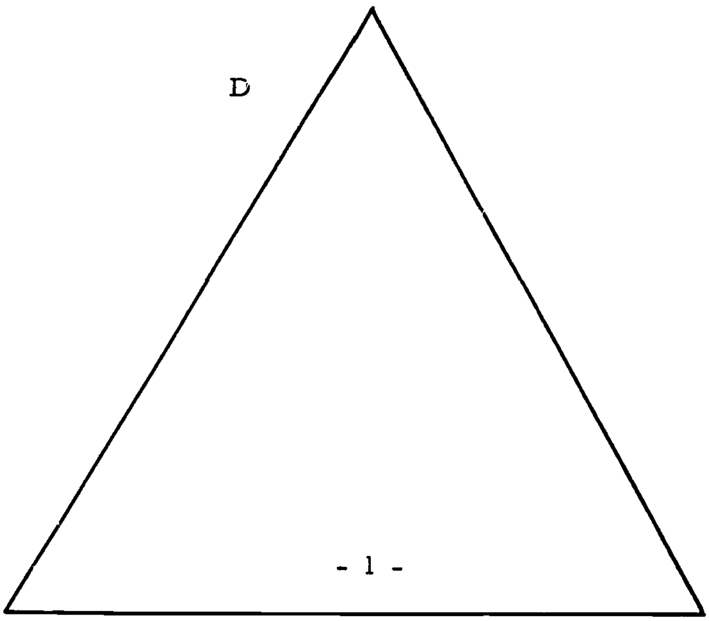


B



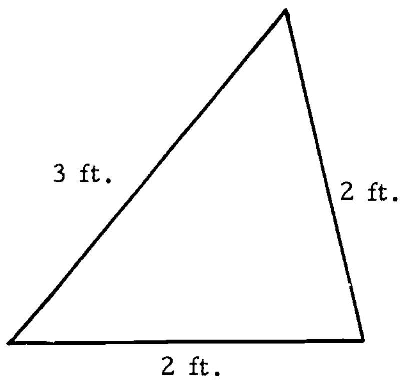
C

D

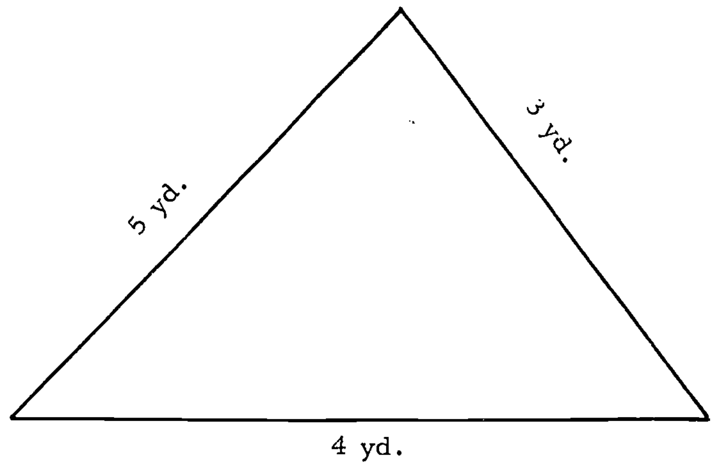


PERIMETER - TRIANGLES

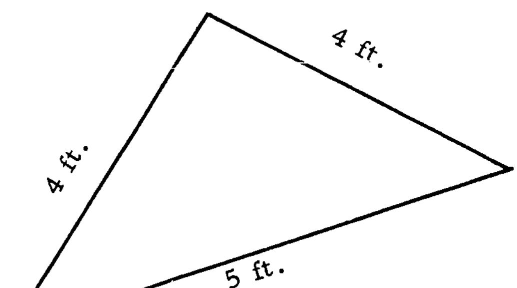
Part II



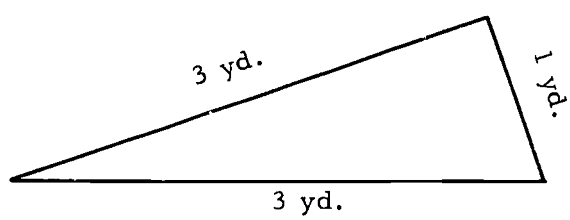
A



B



C



FINDING PERIMETERS OF RECTANGLES

Teacher Commentary

I. Unit: Measurement

II. Objectives: The student should be able to:

   A. Name and identify the perimeter of a rectangle

   B. Demonstrate how to find the perimeter of a rectangle by measuring

   C. State the principle: Perimeter of a rectangle = $2(l + w)$ or $2l + 2w$

   D. Apply this principle by finding the perimeters of various rectangles

   E. Construct drawings of rectangles given their perimeters

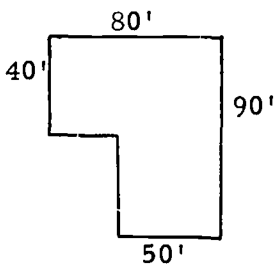
III. Materials:

   A. Rulers

   B. Work sheet entitled, "Finding Perimeters of Rectangles"

IV. Procedure:

   A. Review meaning of perimeter by asking students to find the distance around a figure similar to the one below.



   B. Collect some data by measuring various objects. Use these measurements in developing the formula for finding the perimeter of a rectangle.

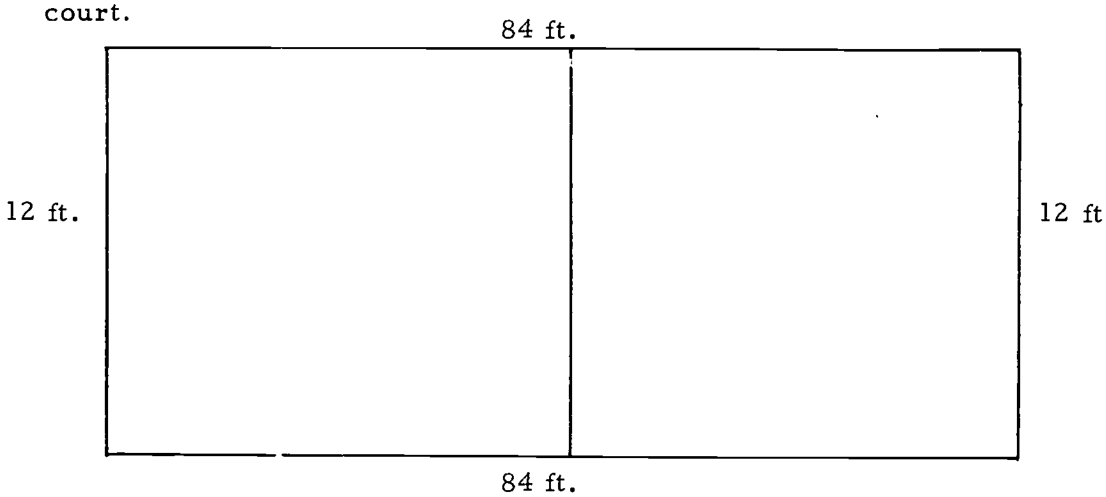
   Some suggested objects which might be measured are desks, text books, paper, chalkboard and the like Students should find the perimeter of these figures using various methods.

   C. Students should state that the perimeter of a rectangle = $2(l + w)$ or $2l + 2w$.

   D. Assessment - Use the formula to find the perimeter of each rectangle shown on work sheet.

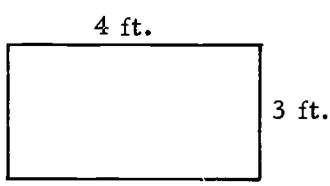
FINDING PERIMETERS OF RECTANGLES

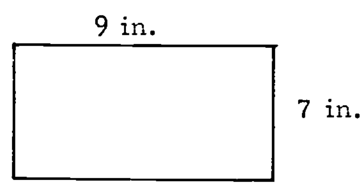
I. Look at the drawing below. It shows the dimensions of a volley ball court.

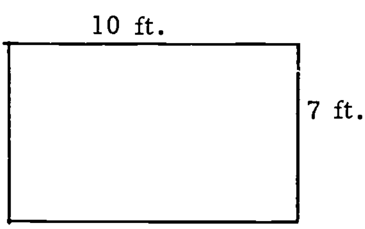


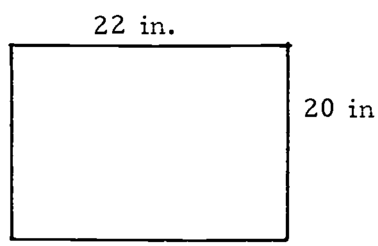
1. The length of this volley ball court is _______ ft.
2. The width of this volley ball court is _______ ft.
3. What is the perimeter of this volley ball court? _______

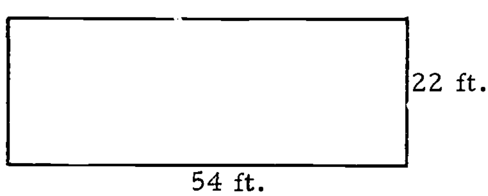
II. Find the perimeter of each of the rectangles drawn below.

1.


2.


3.


4.


5.


III. Construct a drawing of a rectangle having a perimeter of:

A. 26 in.

B. 14 in.

C. 18 in.

NOMOGRAPH - PERIMETER

Teacher Commentary

I. Unit: Measurement

II. Objectives: The student should be able to:

Demonstrate how to construct the perimeter of a square, rectangle and parallelogram using the nomograph

III. Materials:

A. Student work sheet, "Nomograph"

B. A twelve inch ruler

IV. Procedure:

A. Distribute the materials to each student.

B. Discuss the three scales A, B and C.

1. Scales A and B begin with zero and end with twenty. Each unit is divided in half.

2. Scale C begins with zero and ends with eighty.

3. Locate some points on the scales and have the students identify them.

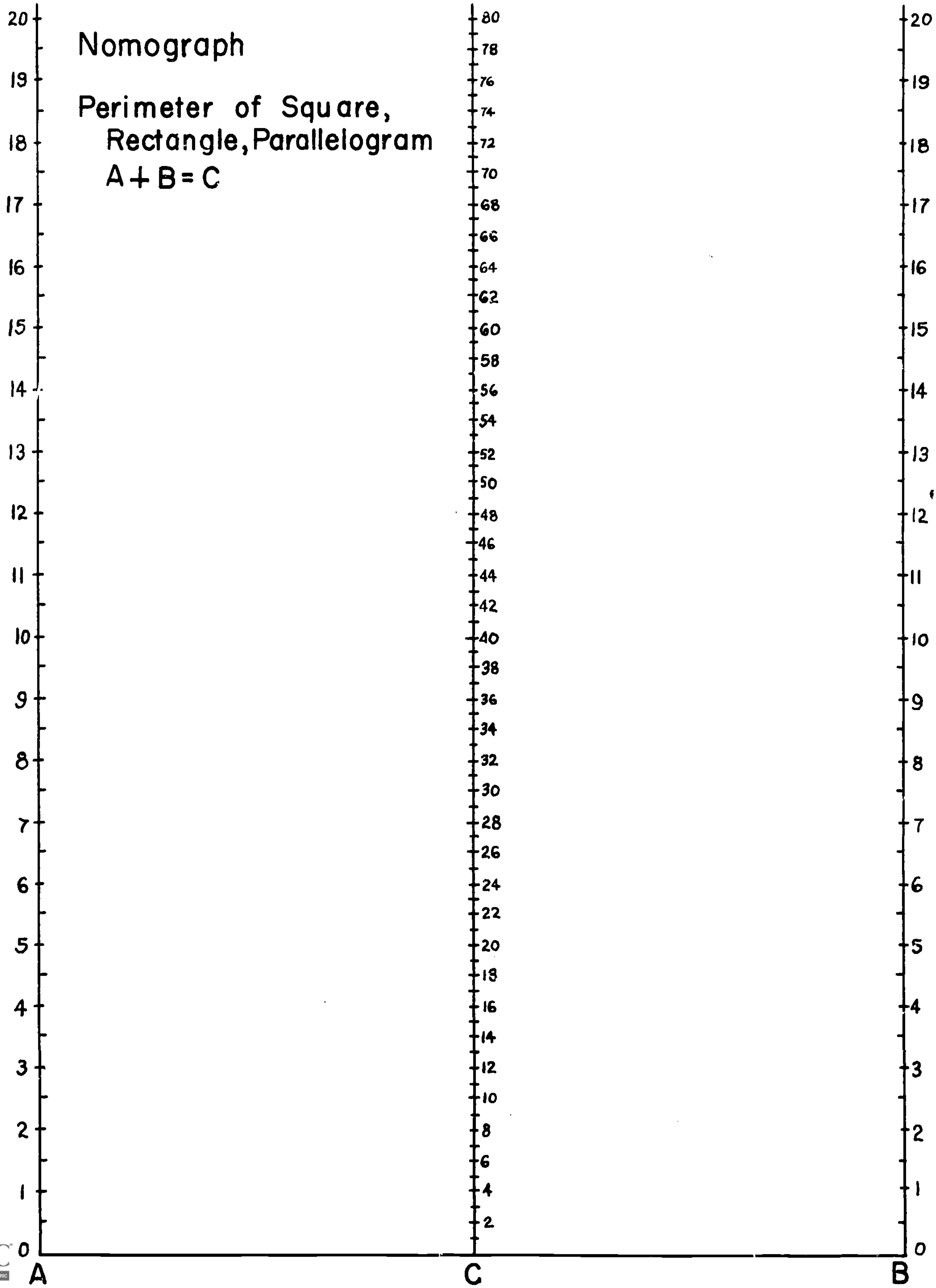
4. Have the students locate points on the scales.

5. Students have to be able to locate and identify given points before learning how to compute the perimeter.

C. In order to find the perimeter of the following rectangle, locate $6\frac{1}{2}$ on scale A and 10 on scale B. The line joining these two points will cross scale C at a point that represents the perimeter (33). The students will have to estimate their answers.

D. In order to find the perimeter of the following square, locate $7\frac{1}{2}$ on scale A and $7\frac{1}{2}$ on scale B. The line joining these two points will cross scale C at a point that represents the perimeter (30).

E. After the students have completed some written exercises, they could use the nomograph to check their results.


Nomograph
Perimeter of Square,
Rectangle, Parallelogram
A + B = C
A
C
B

DIMENSIONS IN SPORTS

Teacher Commentary

I. Unit: Measurement

II. Objectives: The student should be able to:

A. Name and identify the perimeter of a figure as the distance around it

B. State the principle that the perimeter is the sum of the lengths of the sides of the figure

C. Apply the principle to find the perimeter of various figures

III. Materials:

Student sheet entitled, "Dimensions in Sports"

IV. Procedure:

A. Distribute work sheets and discuss the dimensions of each athletic field.

B. Present the students with the problem:

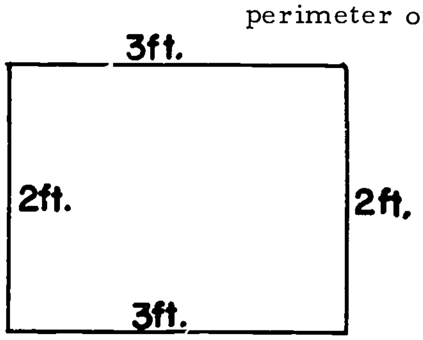
> How far does a player run around the bases, if he hits a home run?
>
> Let the students solve the problem in various ways.

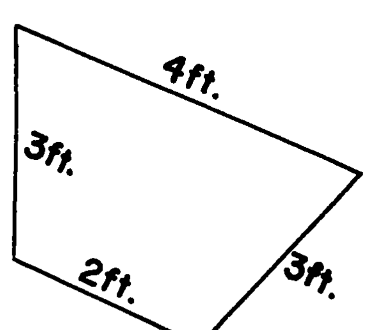
C. Use the other diagrams to find the distance around the other athletic fields.

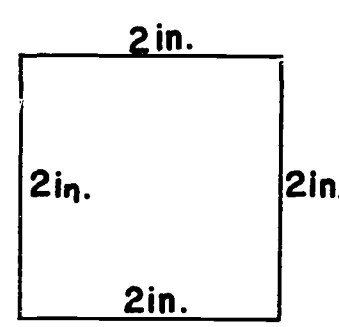
D. Bring out the idea that the distances around these fields may also be called the perimeters of the fields.

E. Review how they found the perimeter of each field. The students should be able to state the principle that the perimeter is the sum of the lengths of the sides of each figure.

F. To evaluate the lesson the students should be asked to find the perimeter of these figures, drawn on the chalkboard.

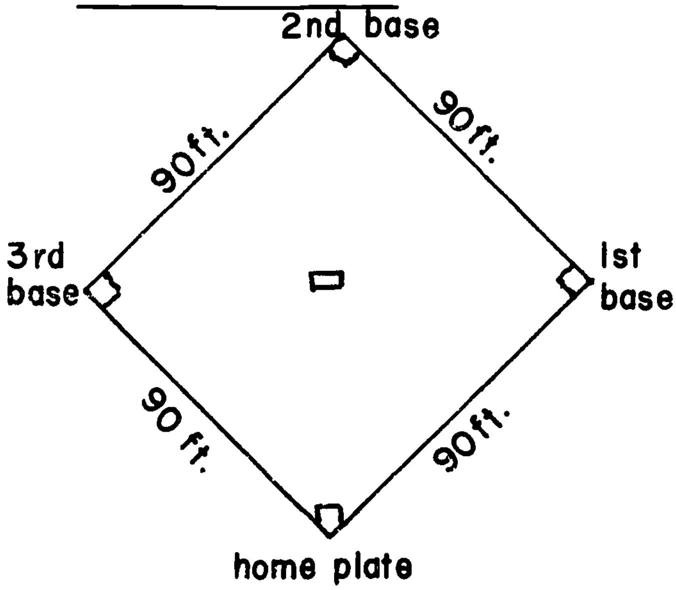




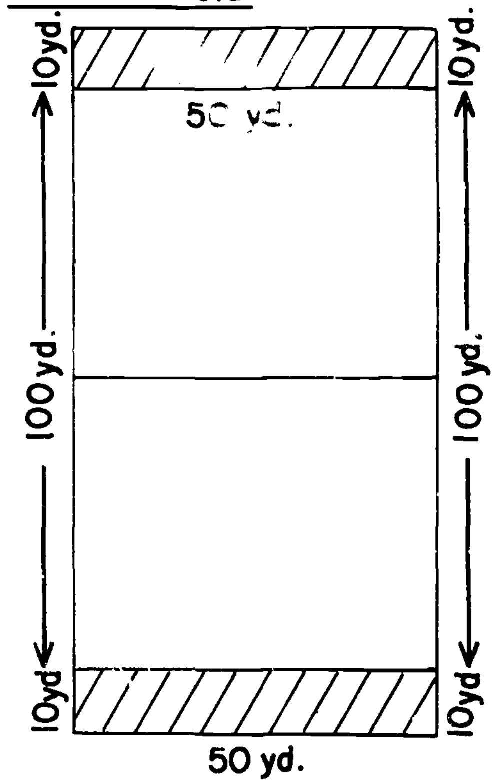


DIMENSIONS IN SPORTS

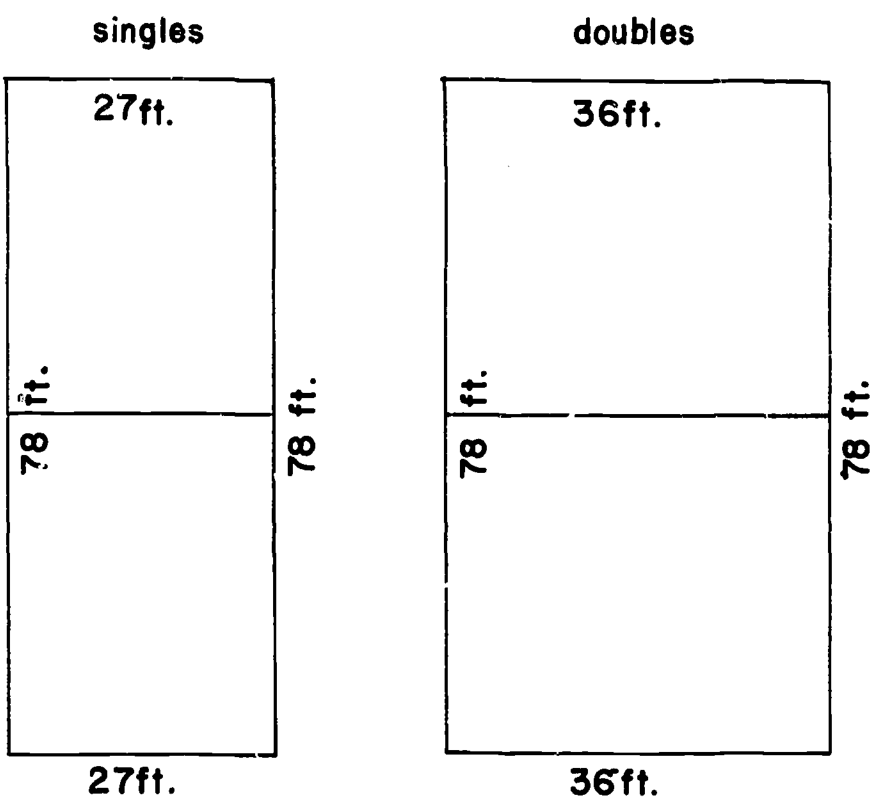
Baseball Diamond



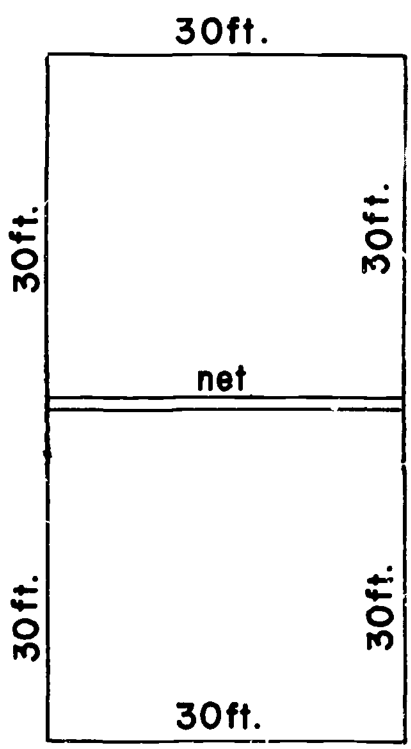
Football Field



Tennis Courts



Volley Ball Court



AREA OF A RECTANGLE BY SWEEPS

Teacher Commentary

I. Unit: Measurement

II. Objectives: The student should be able to:

A. Name and identify the area of a rectangle

B. State the principle that the area of a rectangle is equal to the length times the width

C. Apply the principle by finding the area of various figures, given their dimensions

III. Materials:

A. Model of the sweep for the rectangle

B. Colored chalk

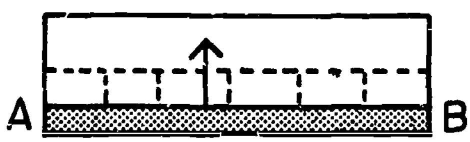
IV. Procedure:

A. This material may be used with students who have difficulty understanding area.

B. Explain to the student that a sweep is a segment which moves across the interior region of a plane figure covering the entire region.

C. If you have a model of a sweep, show them the sweep for the rectangle and have them observe it as it moves across the region.

D. If you have no model, put the following drawing on the board and discuss it.



E. Discuss the following:

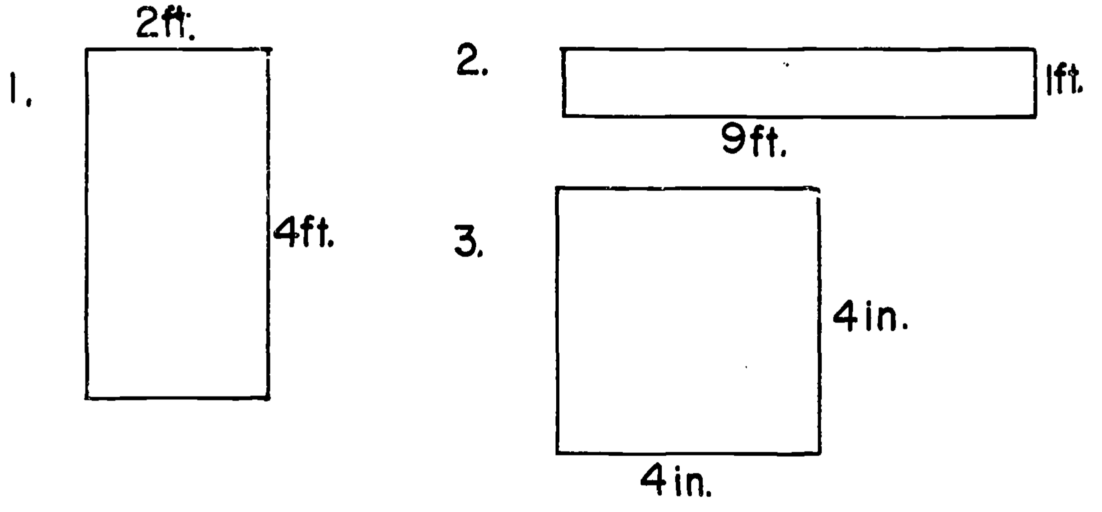
1. Assuming the length of the sweep is 6 units and the sweep is pulled one unit, what is the area represented by the sweep? 6 times 1 or 6 square units

2. If the length of the sweep is 6 units, and if the sweep is pulled two units, the area represented by the sweep is 6 times 2 or 12 square units.

3. If the length of the sweep is 6 units, and if the sweep is pulled w units, the area represented by the sweep is 6 times w.

F. Present other examples of this kind and help the students to discover that the area of a rectangle is equal to the length times the width.

G. Using the following drawings on the board, determine the area of the following rectangles.



H. Discuss the activities performed during the lesson and assess the objectives by:

1. Having one student come to the board and demonstrate how to find the area of a rectangle using sweeps. Colored chalk will work effectively for this demonstration.

2. Asking a student to tell in his own words the rule for finding area of a rectangle.

3. Finding areas of other rectangles.

ATHLETICS AND AREA

Teacher Commentary

I. Unit: Measurement

II. Objectives: The student should be able to:

A. Name and identify the area of a rectangle

B. Demonstrate how to measure its area by using standard units

C. State the principle that the area of a rectangle is equal to the length times the width

D. Apply the principle by finding the area of various figures given their dimensions

III. Materials:

A. Cutouts: square inch, square foot, square yard

B. Graph paper

C. Red pencils

D. Work sheet "Athletics and Area"

IV. Procedure:

A. Review the meaning of area and the square unit of measure.

B. Use graph paper to draw a rectangle 4 inches by 3 inches.

1. Use red pencil to draw in the square inches.

2. Let the students count the number of square inches to find the area.

3. By working with rectangles of different sizes drawn on graph paper, students should discover the formula for finding the area of a rectangular region and state it as $a = l \times w$.

C. Apply the principle by finding the area of various figures given their dimensions.

D. Assess the objectives by having the students complete the work sheet "Athletics and Area."

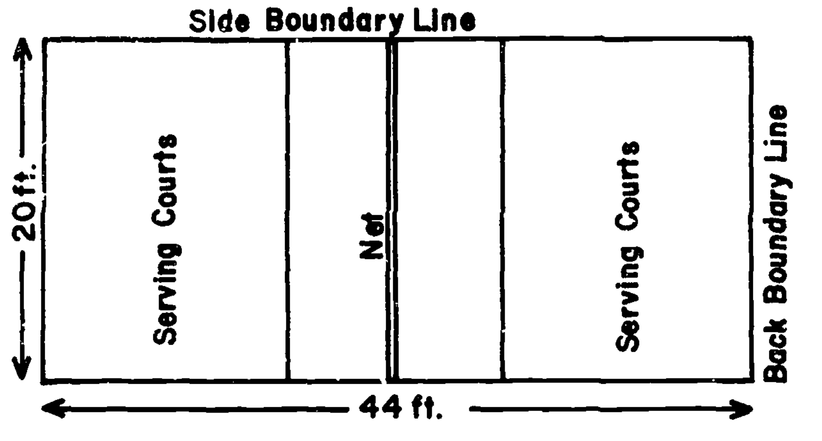
ATHLETICS AND AREA

I. Write the rule for finding the area of a rectangle.

II. A. Look at the dimension of each playing field or court drawn below.

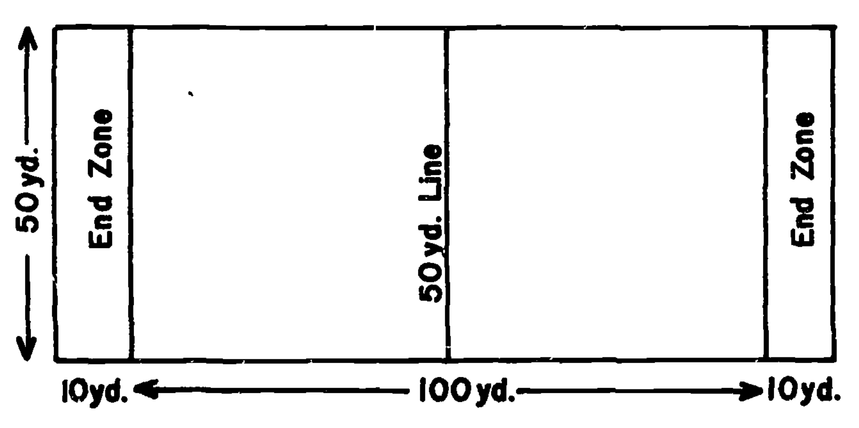
B. Find the area of each. Show your work in the box beside each drawing.

1. Badminton Court



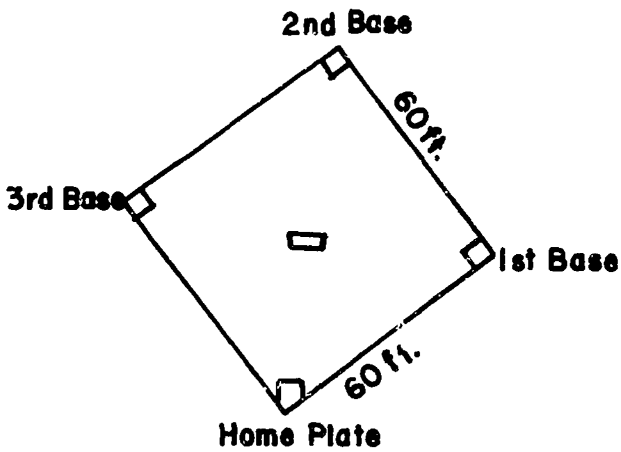
Your Work

2. Football Field



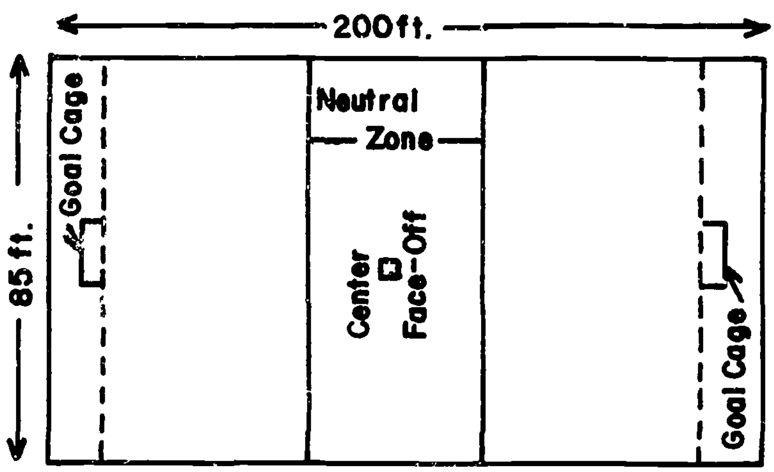
Your Work

3. Softball Diamond



Your Work

4. Ice Hockey



Your Work

BUILDING A DOG PEN

Teacher Commentary

I. Unit: Measurement

II. Objectives: The student should be able to:

A. Apply the principle to find perimeters

B. Apply the principle for finding the area of various figures, given their dimensions

C. Interpret the principles by solving related problems

III. Materials:

Work sheet entitled, "Building a Dog Pen"

IV. Procedure:

A. Distribute the work sheet and help students understand Bill's problem.

1. Let the students attempt to help solve the problem by completing the work sheet.

2. Discuss the following:

a. How the perimeters compare

b. How the areas compare

c. Which rectangular region has the greatest area

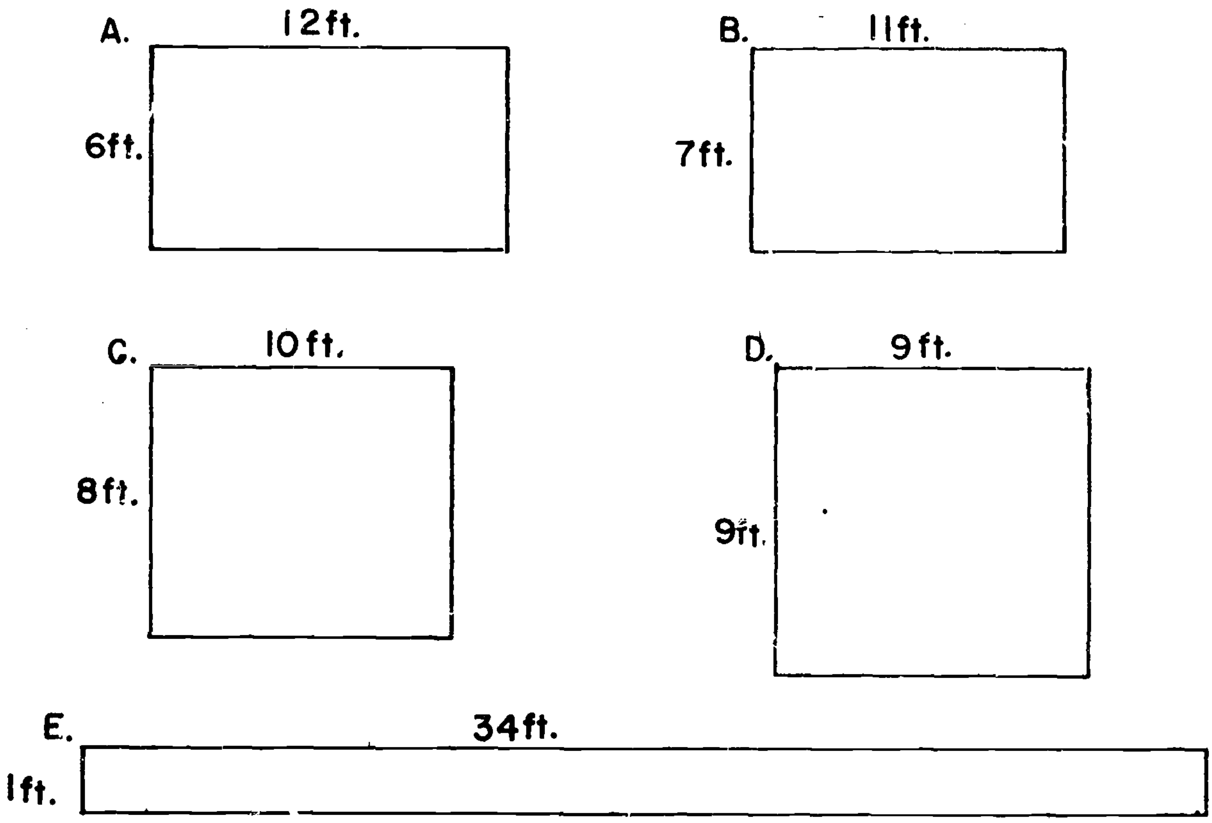
d. Which pen Bill should build

B. Present students with other problems of this nature.

BUILDING A DOG PEN

Bill wants to build a rectangular shaped pen for his dog. He has 36 feet of fencing. He wants to make the space as large as possible.

Bill made the drawings below to help him with his problem.



Can you help Bill solve his problem?

Fill in the following chart to find the pen with the largest area.

Pen	Dimensions of Pen	Perimeter	Area of Pen
A			
B			
C			
D			
E			

PROGRAMED INSTRUCTION

Teacher Commentary

I. Unit: Measurement

II. Objectives: Refer to sheet on objectives for each set of programed booklets.

III. Materials:

A. Student booklets "Measuring Weight"

B. Student booklets "Measuring Length" and rulers

C. Student booklets "Liquid Measure"

IV. Procedure:

A. Using the results of the inventory test given in lesson 18, band 1, and the check list of individual student needs, determine which booklet each student will be given.

B. Distribute to each student one booklet to be worked during the "band." If a student has a weakness in more than one area, he will have the opportunity to work through another booklet during a later lesson.

C. Let students work through the booklets.

D. Collect booklets and check evaluation pages at the end of each booklet by using the solution key on next page.

Solutions

"Measuring Weight" pages 15 and 16

I.	II.	III.
A. 16 oz.	A. 20 oz.	A. 6 lb. 10 oz.
B. 1 lb. 4 oz.	B. 50 oz.	B. 8 oz.
C. 64 oz.	C. 37 oz.	
D. 34 oz.	D. 1 lb. 10 oz.	

"Measuring Length" pages 22 and 23

I.	II.	III.
A. 144	1. B 4 feet A 1 yard, 2 inches C 24 inches	1. 23 inches
B. 3		2. yes
C. 108	2. C 3 yards B 4 feet A 36 inches	
D. 2		
E. 6		

"Liquid Measure" page 17

I.	II.
A. 16	Yes, 3 quarts + 2 pints 3 quarts + 1 quart 4 quarts
B. 6	
C. 40	
D. 12	

PROGRAMED INSTRUCTION

Objectives

I. "Measuring Weight": The student should be able to:

   A. Name and identify the unit of weight: ounce, pound

   B. State the principle: 16 ounces = 1 pound

   C. Apply the principle by changing ounces to pounds or pounds to ounces

   D. Interpret the principle to solve related problems

II. "Measuring Length": The student should be able to:

   A. Name and identify the unit of linear measure: inch, foot, yard

   B. Describe each unit using familiar objects or in terms of other units

   C. State the principles:

      1. 12 in. = 1 ft.

      2. 36 in. = 1 yd.

      3. 3 ft. = 1 yd.

   D. Apply these principles by changing from one unit to another

III. "Liquid Measure": The student should be able to:

   A. Name and identify the units of liquid measure: pint, quart, gallon

   B. State the principles:

      1. 2 pt. = 1 qt.

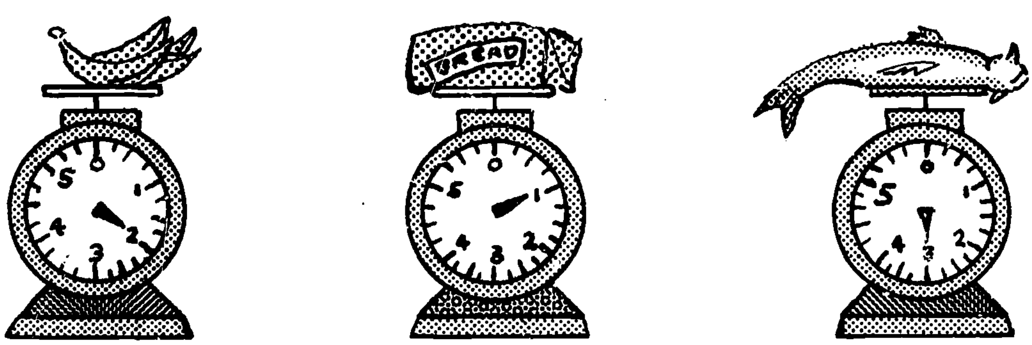
      2. 4 qt. = 1 gal.

      3. 8 pt. = 1 gal.

   C. Apply these principles by changing from one unit to another

Weight Measuring

Measuring Weight



Look at the scales drawn above.

What is the weight in pounds of each of these foods?

Bananas _____ Bread _____ Fish _____

Many foods are sold by the pound.

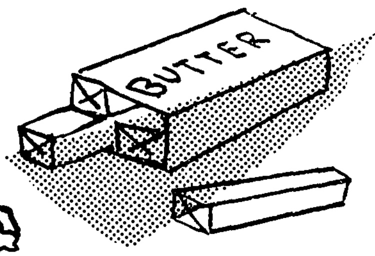
Can you name some? The drawings should help you.

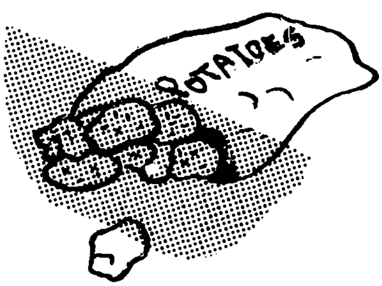
1.

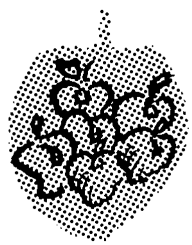
2.

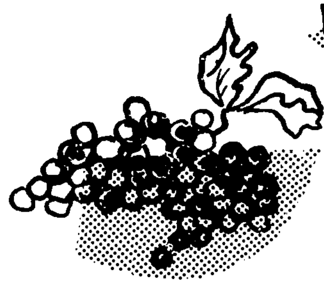
3.

4.





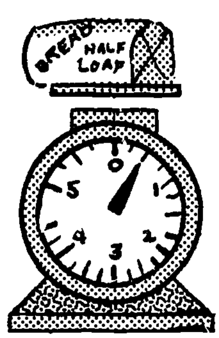




Meat, butter, and some fruits and vegetables are sold by the pound.

Sometimes the food we buy does not weigh an exact pound.

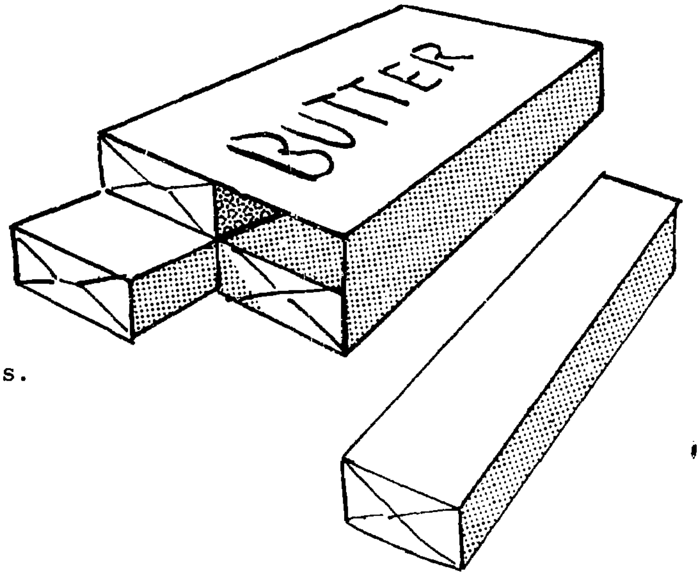
Look at the scale below.



How much do you think the half loaf of bread weighs? ___________

What do the little marks inside the pound marks mean? ___________

The example below may help you to see what the little marks on the scale mean.



The butter in this picture weighs 1 pound.

There are _____ sticks of butter in a pound.

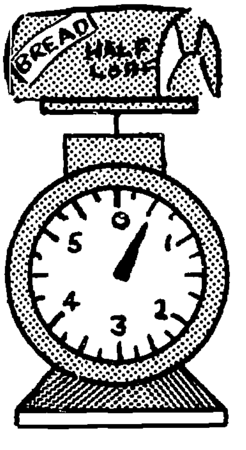
Each stick weighs 4 ounces.

So in 1 pound there are _______ ounces.

16 Ounces = 1 Pound

You could have found this out by multiplying:

4 (The number of sticks of butter in a pound) x 4 ounces (The weight of each stick)



Now, let's look at the drawing of the scale again.
There are 4 spaces between each pound.
Count them.

Each little marks shows the end of a space.

So the pound is divided into 4 equal parts.
Each part measures 4 ounces.

This half loaf of bread weighs _______ ounces.

You should have said the bread weighs 8 ounces.

The arrow is pointing to the second little mark.

Now, let's consider just 1 ounce.

Can you think of something that weighs an ounce? The following problem should help you.

A recipe for making candy calls for 1 ounce of butter.

How many ounces does 1 stick of butter weigh? ____________

(See page 4 if you need help.)

If we cut 1 stick of butter into 4 equal parts, will each part weigh an ounce? ____________

Some things are sold by the pound because they are heavy.

Some things are sold by the ounce because they are light.

Look at the list below. Try to guess if each thing is sold by the pound or by the ounce.

Place an (x) in the column to show how you think they are sold.

	Sold in Ounces	Sold in Pounds
1. Flour		
2. Potatoes		
3. Pepper		
4. Sugar		
5. Cheese		
6. Seeds		
7. Yeast		

You should have filled in the chart as follows:

	Sold in Ounces	Sold in Pounds	
1. Flour		x	
2. Potatoes		x	
3. Pepper	x		
4. Sugar		x	
5. Cheese		x	
6. Seeds	x		
7. Yeast	x		

Now, let's see if you can use the fact you just learned:

16 Ounces = 1 Pound

Fill in the blanks.

1. 6 pounds = _____ ounces
2. 48 ounces = _____ pounds
3. 1 pound, 2 ounces = _____ ounces
4. 33 ounces = _____ pounds _____ ounces
5. 50 ounces = _____ pounds _____ ounces

Check yourself.

1. 6 pounds = <u>96</u> ounces How do you know?

   1 pound = 16 ounces
   6 pounds - <u>96</u> ounces or 6 x 16 ounces = 96 ounces

2. 48 ounces = <u>3</u> pounds How do you know?

   16 ounces = 1 pound
   48 ounces = <u>3</u> pounds or $48 \div 16 = 3$

3. 1 pound, 2 ounces = <u>18</u> ounces How do you know?

   1 pound + 2 ounces

   16 ounces + 2 ounces = 18 ounces

4. 33 ounces = <u>2</u> pounds <u>1</u> ounce How do you know?

   33 ounces = 32 ounces + 1 ounce
   2 pounds + 1 ounce or $33 \div 16 = 2$ pounds with 1 ounce left over

5. 50 ounces = <u>3</u> pounds <u>2</u> ounces How do you know?

   50 ounces = 48 ounces + 2 ounces
   3 pounds + 2 ounces or $50 \div 16 = 3$ pounds with 2 ounces left over

We can write "pound" and "ounce" in a short way.

Look at the box below.

16 Oz. = 1 Lb.

Instead of writing "pound," we wrote ___________.

Instead of writing "ounce," we wrote ___________.

From now on when we talk about "pounds," we will write <u>lb.</u>

From now on when we talk about "ounces," we will write <u>oz.</u>

Now, let's try solving some problems using what you have learned.

Read each problem.

Write the answer on the line to the right.

1. Bob's candy bar weighs 2 oz. How many of his candy bars will make a lb. ? __________

2. Joan has a 3 lb. box of cookies. How many ounces is this? __________

3. Mrs. Brown bought $\frac{1}{2}$ lb. of cream cheese and 8 oz. of sharp cheese. Did she buy a lb. of cheese? __________

Check yourself.

1.	8 candy bars	How do you know?	8 x 2 oz. = 16 oz. or 1 lb.
2.	48 oz.	How do you know?	3 x 16 oz. = 48 oz.
3.	Yes	How do you know?	$\frac{1}{2}$ lb. = 8 oz. 8 oz. + 8 oz. = 16 oz. or 1 lb.

Now try this tricky one. Be careful. It may tickle you.

Which is heavier; a lb. of coal or a lb. of feathers? ______________

Were you clever enough to say that both weighed the same?

Now let's review what you have learned.

1. 16 ounces (oz.) = 1 pound (lb.)
2. A short way to write ounces is oz.
3. A short way to write pounds is lb.
4. Many foods are sold by the pound or ounce:

   candy, sugar, potatoes, grapes, apples, butter, cheese
5. To change ounces to pounds you divide by 16.
6. To change pounds to ounces you multiply by 16.

Now, let's see how much you remember.

I. Fill in the blanks.

A. 1 lb. = _____ oz.

B. 20 oz. = _____ lb. _____ oz.

C. 4 lb. = _____ oz.

D. 2 lb., 2 oz. = _____ oz.

II. Which is greater? Circle your answer.

A. 1 lb. 2 oz. or 20 oz.

B. 3 lb. or 50 oz.

C. 37 oz. or 2 lb.

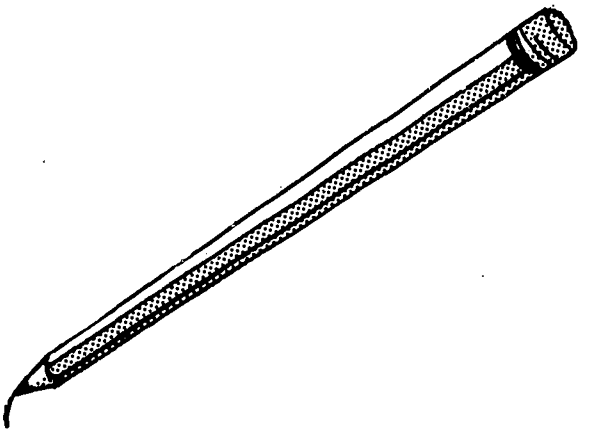
D. 25 oz. or 1 lb. 10 oz.

III. Read the problem.

Write your answer on the line at the right.

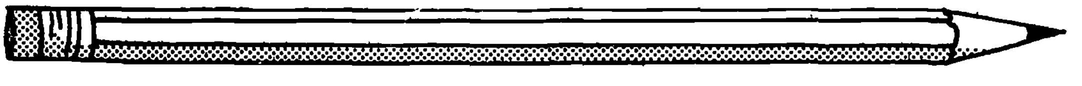
A. Mrs. Jones bought meat that weighed 4 lb. 4 oz., a box of rice that weighed 1 lb. 1 oz. and a box of frozen carrots that weighed 1 lb. 5 oz. How much did all of this weigh? ____________

B. Mother bought a 1 pound box of sugar. She has used half of it. How many ounces of sugar does she have left? ____________



Measuring Length

Measuring Length



Look at the drawing of the pencil.

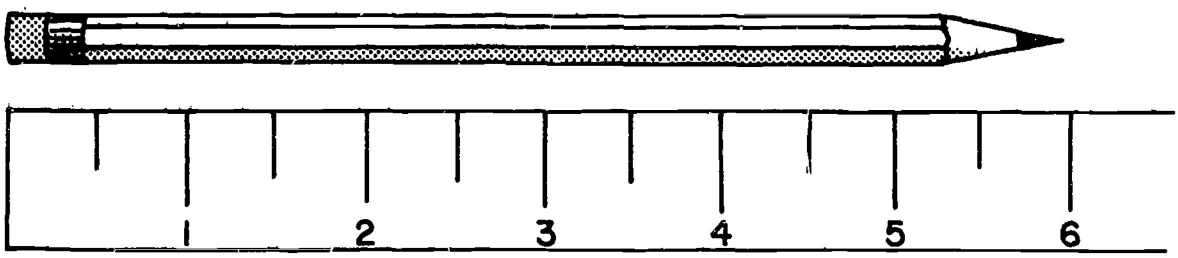
Name the length of the pencil in inches. Use the ruler you made.

The length of the pencil is __________ inches.

Did you find the pencil was 6 inches long?

If you did, go to page 3.

If you did not, look at the picture below.



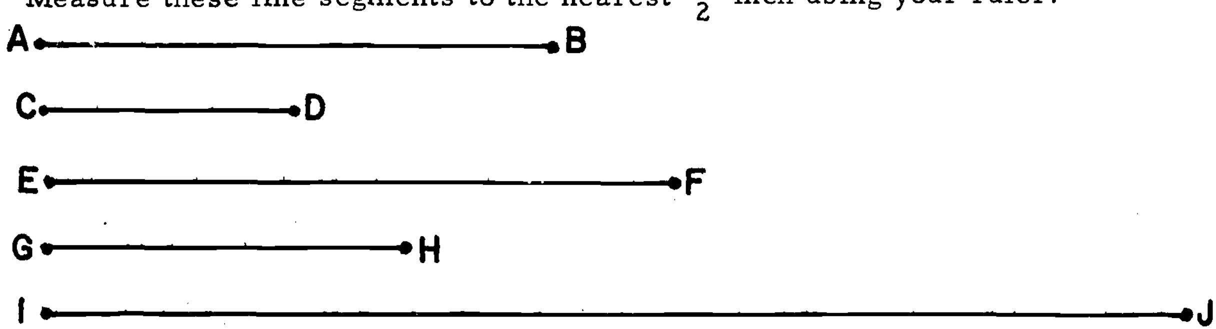
Notice where the beginning of the ruler is placed.

Look at the point of the pencil.

See where this falls on the ruler.

Count the number of inch units marked by the dotted lines.

Measure these line segments to the nearest $\frac{1}{2}$ inch using your ruler.



Line Segment AB = __________ inches.

Line Segment CD = __________ inches.

Line Segment EF = __________ inches.

Line Segment GH = __________ inches.

Line Segment IJ = __________ inches.

Check yourself.

Line Segment AB = 3 inches.

Line Segment CD = $1\frac{1}{2}$ inches.

Line Segment EF = $3\frac{1}{2}$ inches.

Line Segment GH = 2 inches.

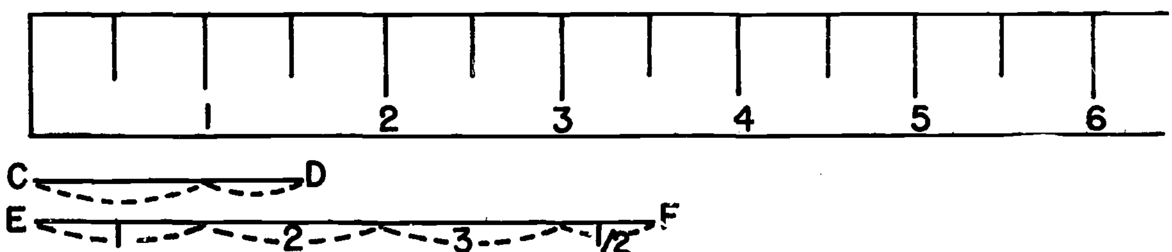
Line Segment IJ = $6\frac{1}{2}$ inches.

Did you get all of these right?

If you did, go on to page 6.

If you did not, go on to page 5.

Look at the picture of the ruler below.



You know how to find the inch marks on the ruler.

Let's talk about the $\frac{1}{2}$ inch marks. The $\frac{1}{2}$ inch marks are the shorter lines between the inch markings.

Line segment CD was $1\frac{1}{2}$ inches long. Find this on the ruler. The letters will help you.

Line segment EF was $3\frac{1}{2}$ inches long. Find this length on the ruler.

Go back to page 3 and measure the line segments again.

Now, let's think about the pencil we measured.

Remember it was 6 inches long.

How many of these pencils placed end to end will equal a foot?

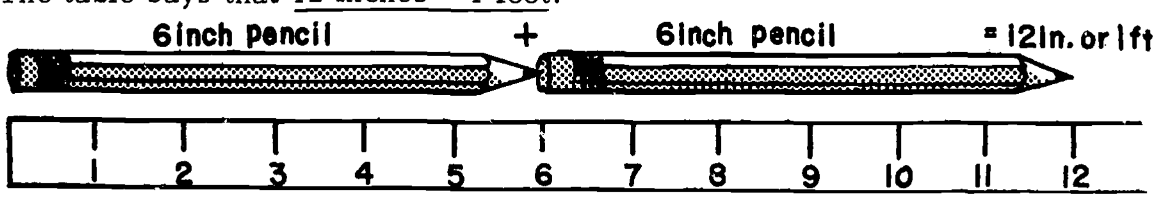
__________ Pencils will equal 1 foot.

If you need help, look at the table below.

12 Inches (In.)	=	1 Foot (Ft.)
3 Feet (Ft.)	=	1 Yard (Yd.)
36 Inches (In.)	=	1 Yard (Yd.)

You should have written 2 pencils will equal 1 foot.

The table says that 12 inches = 1 foot.



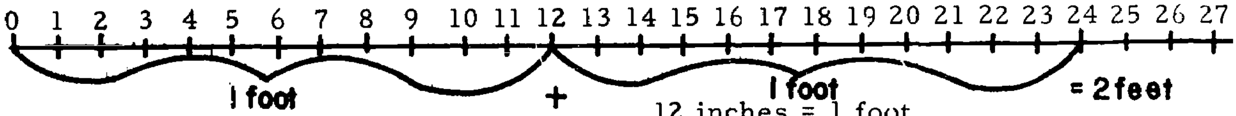
Use this fact to complete the following sentences: 12 inches = 1 foot

1. 24 inches = _______ ft.
2. 3 feet = _______ inches
3. 5 feet = _______ inches

Check your answers.

1. 24 inches = 2 feet

How do you know? Look at the number line below.



Another way to show this is, since 12 inches = 1 foot / 24 inches = 2 feet or

24 ÷ 12 = 2 ft.

Why do you divide by 12? Because there are 12 inches in each foot.

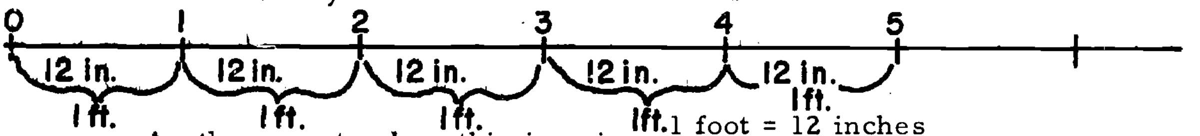
2. 3 feet = 36 inches

How do you know? Look at the number line below.

Since 1 foot = 12 inches / 3 feet = 36 inches or 3 x 12 inches = 36 inches.

3. 5 feet = 60 inches

How do you know? Look at the number line.



Another way to show this is, since 1 foot = 12 inches / 5 feet = 60 inches or

5 x 12 inches = 60 inches.

Now let's think about what we did.

1. When we changed inches to feet, we got a smaller number because it takes 12 inches to make 1 foot. To change inches to feet, you divide by 12.

2. When we changed feet to inches. We got a larger number because 1 foot contains 12 inches. To change feet to inches, you multiply by 12.

Now let's use these facts to work some more problems.

Remember: $\boxed{\text{12 inches = 1 foot}}$

1. 48 inches = ____ feet

2. 2 feet = _____ inches

3. 16 inches = _____ ft. _____ in.

4. 1 foot 10 inches = _____ inches

Check yourself.

1. 48 inches = <u>4</u> feet Did you think 12 inches = 1 foot / 48 inches = <u>4</u> feet or

$48 \div 12 =$ feet

Remember: To change inches to feet <u>divide</u> by 12.

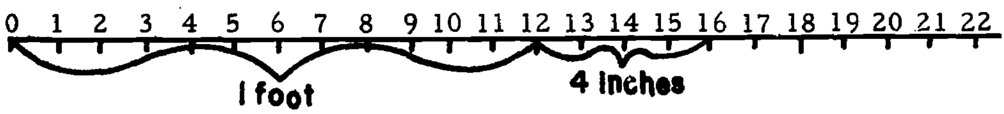
2. 2 feet = <u>24</u> inches Did you think 1 foot = 12 inches / 2 feet = <u>24</u> inches or

$2 \times 12 =$ inches

Remember: To change feet to inches <u>multiply</u> by 12.

3. 16 inches = <u>1</u> ft. <u>4</u> in. How do you know?

First, look at the number line.



Or we could write: $16 \div 12 =$ 1 foot with 4 inches left over.

4. 1 foot 10 inches = <u>22</u> inches How do you know?

1 foot = 12 inches 12 inches + 10 inches = 22 inches

You have used the fact $\boxed{\text{12 inches = 1 foot}}$

Do you remember how many feet = 1 yard?

If not, turn back to page 6 and check the table.

_____ feet = 1 yard

Which of these things are about a yard in length?

1. A baseball bat
2. The length of the chalkboard
3. The length of the curtain rod in your classroom
4. The distance from your nose to the tip of your fingers.

5. The length of your shoe

Check yourself. Did you select these items?

1. A baseball bat
3. The length of a curtain rod in your classroom
4. The distance from your nose to the tip of your fingers

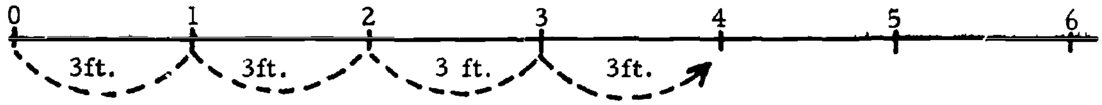
You know that: $\boxed{\text{3 feet = 1 yard}}$

Now let's use that fact to complete the following:

1. 4 yards = _____ feet
2. 9 feet = _____ yards
3. 2 yards, 1 foot = _____ ft.

Check yourself.

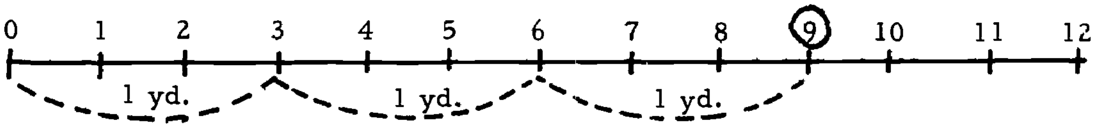
1. 4 yard = 12 feet   How do you know? Look at the number line.



Perhaps you thought 1 yard = 3 feet
3 yards = 12 feet or $4 \times 3 = 12$

We multiply by 3 because there are 3 ft. in each yard.

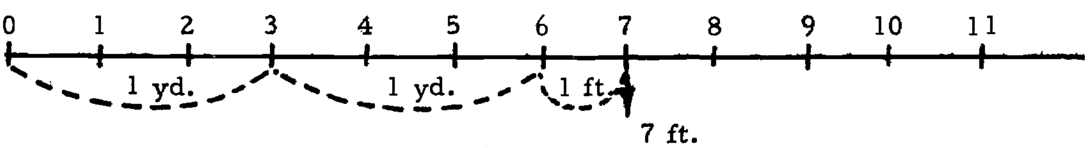
2. 9 feet = 3 yd.   How do you know? Look at the number line.



Perhaps you thought 3 feet = 1 yard
9 feet = 3 yards or $9 \div 3 = 3$ yd.

We divide by 3 because each yard = 1 foot.

3. 2 yards, 1 foot = 7 feet   How do you know?



Perhaps you thought 2 yards + 1 foot
6 feet + 1 foot = 7 feet

Now let's think about what we did:

1. When we changed feet to yards, we divided by 3.
   This was because for each yard there are 3 feet.
   To change feet to yards, divide by 3.

2. When we changed yards to feet, we multiplied by 3.
   This was because for each yard there are 3 feet.
   To change feet to yards, multiply by 3.

You have used two facts:

12 In.	=	1 Ft.
3 Ft.	=	1 Yd.

Do you remember how many inches there are in 1 yd. ?
Can you find the answer using the facts given above?

_____ Inches = 1 Yard

Use the table on page 6 to see if you are right.

36 Inches = 1 Yard

Use this fact to complete the following:

1. 5 yards = _____ inches
2. 72 inches = _____ yards
3. 2 yards, 5 inches = _____ inches
4. 42 inches = _____ yards _____ inches

Check yourself.

1. 5 yards = 180 inches — How do you know?

   1 yd. = 36 in.
   5 yd. = 180 in. — or 5 x 36 = 180 in.

2. 72 inches = 2 yards — How do you know?

   36 in. = 1 yd.
   72 in. = 2 yd. — or 72 ÷ 36 = 2 yd.

3. 2 yards, 5 inches = 77 inches — How do you know?

   2 yd. + 5 in.
   72 in. + 5 in. = 77 in. — or 2 x 36 = in.; in. + 5 in. = in.

4. 42 inches = 1 yard 6 inches — How do you know?

   42 in. = 36 in. + 6 in.
   1 yd. + 6 in. — or 42 ÷ 36 = 1 yd. 6 inches

Now let's review.

1 foot = _____ inches

1 yard = _____ inches

1 yard = _____ feet

Can you name something that is:

1. About a foot long ______________________________
2. About an inch long ______________________________
3. About a yard long ______________________________

Some things to remember:

1. When we change inches to feet, we get a smaller number of feet than inches. This is because there are 12 inches in each foot. Look at this example.

   24 inches = 2 feet   For each foot we need 12 in.

   To change inches to feet, we divide by 12.
2. When we change feet to inches, we get a larger number. This is because each foot contains 12 inches.

   To change feet to inches, we multiply by 12.
3. When we change yards to feet, we get a larger number. This is because there are 3 feet in each yard.

   To change yards to feet, we multiply by 3.

Now, let's see how much you remember.

I. Complete the following:

A. 4 yards = _____ inches

B. 9 feet = _____ yards

C. 9 feet = _____ inches

D. 72 inches = _____ yards

E. 72 inches = _____ feet

II. Put each set of measures in order of size from largest to smallest.

1. a. 1 yard, 2 inches   b. 4 feet   c. 24 inches

2. a. 36 inches   b. 4 feet   c. 3 yards

III. A. Read each problem.

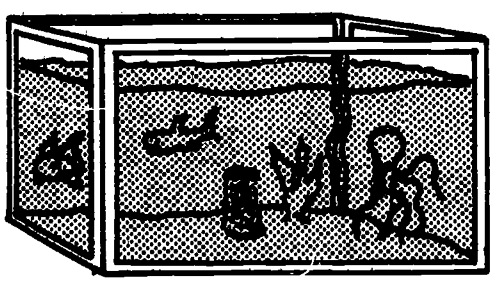
B. Write the answer on the line to the right.

1. Mary has a yard of ribbon. She used 13 inches of it. How many inches of ribbon does Mary have left? ____________

2. Bob needs a piece of wood 16 inches long. He needs another piece 9 inches long. Can Bob cut both pieces from a piece 1 yard long? ____________

LIQUID MEASURE

Liquid Measure



Tom wants to clean his aquarium and put in fresh water.

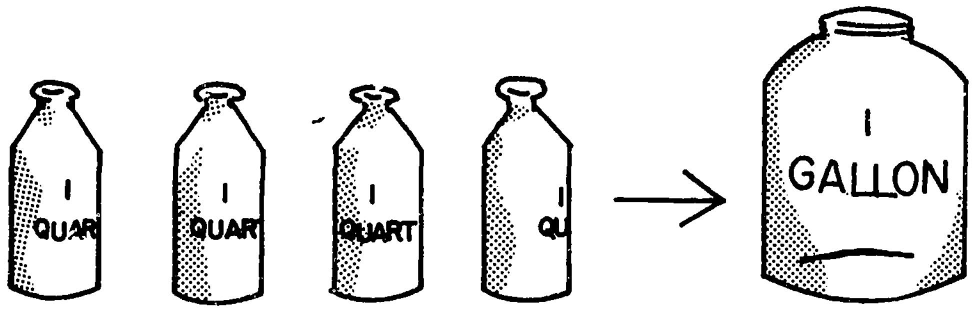
The aquarium holds 2 gallons of water.

Tom only has a quart milk bottle.

How many quart bottles of water will he need to fill the aquarium? ________

Did you write 8 quarts?

Look at the drawing below. It will help you see how to get the answer.



4 QUARTS = 1 GALLON

So if we want 2 gallons, we need 2 times as many quarts or 8 quarts.

We can say that: 2 Gallons = ______ Quarts.

The number sentence below tells what we did

2 x 4 Quarts = 8 Quarts

Now let's see if you can use this fact to work some problems.

Remember: $\boxed{\text{4 QUARTS = 1 GALLON}}$

I. Read the problem. Write your answer.

1. Bob bought 2 quarts of chocolate ice cream and 2 quarts of vanilla ice cream.

   Did Bob buy a gallon of ice cream? ______________

2. Sue's mother gets 3 quarts of milk from the milkman 4 times a week.

   How many quarts of milk a week does Sue's mother buy? _________

   How many gallons of milk is this equal to? ________

Go on to the next page.

II. Complete the following:

1. 3 gallons make ______ quarts

   Hint: 1 gallon = 4 quarts

   3 gallons = quarts

2. 20 quarts make ______ gallons

   Hint: 4 quarts = 1 gallon

   20 quarts = gallons

3. 6 quarts make ______ gallons ______ quarts

4. 3 gallons and 3 quarts make ______ quarts

5. 9 quarts make ______ gallons ______ quarts

Turn the page to check yourself.

I. 1. Yes Bob bought 1 gallon of ice cream.

   2 quarts + 2 quarts = 4 quarts or 1 gallon

2. 12 Quarts Sue's mother bought 12 quarts of milk.

   How do you know? 4 x 3 quarts = 12 quarts

   3 Gallons 12 quarts = 3 gallons Why? $12 \div 4 = 3$

II. 1. 4 gallons = 16 quarts 4 x 4 quarts = 16 quarts

2. 20 quarts = 5 gallons $20 \div 4 = 5$ gallons

3. 6 quarts = 1 gallon 2 quarts $6 \div 4 = 1$ r 2

4. 3 gallons and 3 quarts = 15 quarts 3 x 4 quarts = 12 quarts

   12 quarts + 3 quarts = 15 quarts

5. 9 quarts = 2 gallons 1 quart $9 \div 4 = 2$ r 1

Now, let's think about what we did.

1. When we changed quarts to gallons, we divided by 4.

   This was because it took 4 quarts to make each gallon.

   <u>To change quarts to gallons, divide by 4</u>.

2. When we changed gallons to quarts, we multiplied the number of gallons x 4 quarts.

   This was because for each gallon there were 4 quarts.

   <u>To change gallons to quarts, multiply by 4</u>.

You now know that $\boxed{\text{4 Quarts} \;=\; \text{1 Gallon}}$

To save space we could write this same fact another way.

$\boxed{\text{4 Qt.} \;=\; \text{1 Gal.}}$

Instead of writing "quart" we wrote ________.

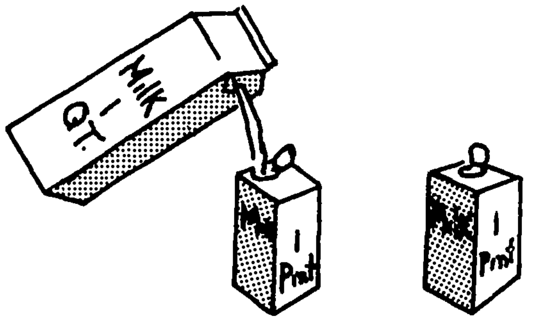
Instead of writing "gallon" we wrote ________.

From now on, when we talk about gallons, we will write <u>gal.</u>

From now on, when we talk about quarts, we will write <u>qt.</u>

Sometimes we use a smaller unit than qt. and gal.

Look at the drawing below. It will help you see the small unit.



The smaller unit we are talking about is the pint.

$\boxed{\text{1 Qt. = 2 Pints}}$

In other words, ______ pints make 1 qt.

Now, let's use this fact to work some problems.

Remember: $\boxed{\text{2 PINTS = 1 QT.}}$

I. Fill in the blanks.

1. 18 pints = ______ qt.

   Hint: 2 pints = 1 quart   18 pints =   quarts

2. 6 qt. = ______ pints

   Hint: 1 quart = 2 pints   6 quarts =   pints

3. 2 qt. 1 pint = ______ pints

4. 21 pints = ______ qt. ______ pint

II. Which is greater? Circle your answer.

1. 3 pints or 2 qt.

2. 5 pints or 2 qt.

3. $\frac{1}{2}$ pint or $\frac{1}{2}$ qt.

Check yourself.

Did you think:

I. 1. 18 pints = 9 qt. — 2 pints = 1 qt.; 18 pints = 9 qt. or $18 \div 2 = 9$

2. 6 qt. = 12 pints — 1 qt. = 2 pints; 6 qt. = 12 pints or $6 \times 2 = 12$

3. 2 qt. 1 pint = 5 pints — 2 qt. + 1 pint

4 pints + 1 pint = 5 pints

4. 21 pints = 10 qt. 1 pint — 21 pints = 20 pints + 1 pint

10 qt. + 1 pint

II. 1. 3 pints or 2 qt.

2. 5 pints or 2 qt.

3. $\frac{1}{2}$ pint or $\frac{1}{2}$ qt.

Now, let's think about what we did.

1. When we changed pints to qt. we divided by 2.

   This was because it took 2 pints to make each qt.

   To change pints to qt., divide by 2.

2. When we changed qt. to pints, we multiplied the number of qt. x 2 pints.

   This was because for each qt. there were 2 pints.

   To change qt. to pints, multiply by 2.

The table tells all the things we have talked about.

Row 1	GAL.							
Row 2	QT.		QT.		QT.		QT.	
Row 3	PT.	PT.	PT.	PT.	PT.	PT.	PT.	PT.

Row 1 - Shows the gallon. It is the largest unit we talked about.

Row 2 - Shows there are 4 qt. in 1 gal.

Row 3 - Stands for pints. Instead of writing the word pint, we used the short form. The short form for pint is ________.

Row 3 - Also shows there are 2 pt. in 1 qt.

Row 3 - Also tells you that: _______ pt. = 1 gal.

Now, let's use the fact:

$$\boxed{8 \text{ Pt.} = 1 \text{ Gal.}}$$

I. Fill in the blanks.

16 pt. = ________ gal.

3 gal. = ________ pt.

9 pt. = ________ gal. ________ pt.

1 gal. 3 pt. = ________ pt.

II. Which is greater? Circle your answer.

1. 1 gal. or 7 pt.
2. 2 gal. or 17 pt.
3. 1 gal. 2 pt. or 11 pt.

Check your work.

Did you think:

I.	16 pt. = 2 gal.	8 pt. = 1 gal. 16 pt. = 2 gal.	or	16 ÷ 8 = 2 gal.
	3 gal. = 24 pt.	1 gal. = 8 pt. 3 gal. = 24 pt.	or	3 x 8 = 24 pt.
	9 pt. = 1 gal. 1 pt.	9 ÷ 8 = 1 gal, r 1 pt.		
	1 gal. 3 pt. = 11 pt.	1 gal. = 8 pt., 8 pt. and 3 pt. = 11 pt.		

II. Which is greater?

1. 1 gal. or 7 pt.
2. 2 gal. or 17 pt.
3. 1 gal. 2 pt. or 11 pt.

You now know these facts about liquid measures:

1.

2 Pt.	=	1 Qt.
4 Qt.	=	1 Gal.
8 Pt.	=	1 Gal.

2. To change pt. to qt., we divide by ______.
3. To change qt. to pt., we multiply by ______.
4. To change qt. to gal., we divide by ______.
5. To change gal. to qt., we multiply by ______.
6. To change pt. to gal., we divide by ______.
7. To change gal. to pt., we multiply by ______.

Do you know some things you buy by the quart, gallon, or pint?
Can you name some? The drawings will help you.

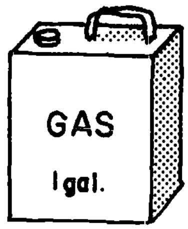
1.

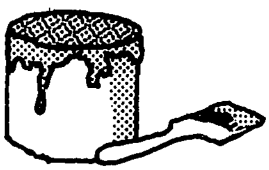
2.

3.

4.

5.





Now, let's see how much you remember.

I. Fill in the blanks.

A. 4 gal. = _______ qt.

B. 48 pt. = _______ gal.

C. 10 gal. = _______ qt.

D. 6 qt. = _______ pt.

II. Read the problem. Write the answer on the line to the right.

Tom's mother sent him to the store for a gallon of milk. He could not find a gallon bottle of milk. So Tom bought 3 quarts and 2 pints. Did Tom buy the right amount of milk? __________

GRAPHING

GRAPHING

UNIT GRAPHING GRADE(S) Seven through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Pictograph	7	7		7	7		7	7		
Bar Graph	7	7		7	7		7	7		
Line Graph	7	7		7	7		7	7		
Circle Graph	7	7			7		7	7		
Number Line	8	8		8	8	8	8			
Graphing Equalities	8	8		8		8				
Cartesian Products	8	8		8						
Graphing Ordered Pairs in First Quadrant	8	8	8	8	8					8
Coordinate Axes	9	9	9	9	9					9
Graphing Ordered Pairs	9	9	9	9	9	9	9			
Quadrants	9	9			9	9	9			
Table of Values	9	9	9	9	9			10		
Graphing Formulas	9	9		9	9			10		
Graphing Linear Equations and Inequations	10	10		10	10					10
Slope	10	10			10	10	10			
Graphing Simultaneous Equations	11	11		11	11	11	11			
Graphing Quadratic Equations and Inequations	11	11		11	11					11

UNIT GRAPHING GRADE(S) Seven

TOPIC	NAME	IDENTIFY	DEMON- STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN- GUISHING
Pictograph	7	7		7	7		7	7		
Bar Graph	7	7		7	7		7	7		
Line Graph	7	7		7	7		7	7		
Circle Graph	7	7			7		7	7		

Pictograph, Bar Graph, Line Graph, Circle Graph	Page
The student should be able to:	
1. Name and identify a pictograph, bar graph, line graph, and circle graph	GR-5
2. Construct pictographs, bar graphs, and line graphs given appropriate data	
3. Describe a pictograph, bar graph, line graph, and circle graph	
4. Apply the principles of graphs by reading information from them	
5. Interpret each graph by drawing conclusions	

HOT CHOCOLATE AT COLT GAMES

Teacher Commentary

I. Unit: Graphing

II. Objectives: The student should be able to:

- A. Name and identify a bar graph
- B. Describe a bar graph
- C. Apply the principle of the bar graph by reading the information from them
- D. Interpret the bar graph by drawing conclusions

III. Materials: Student work sheets "Hot Chocolate At Colt Games"

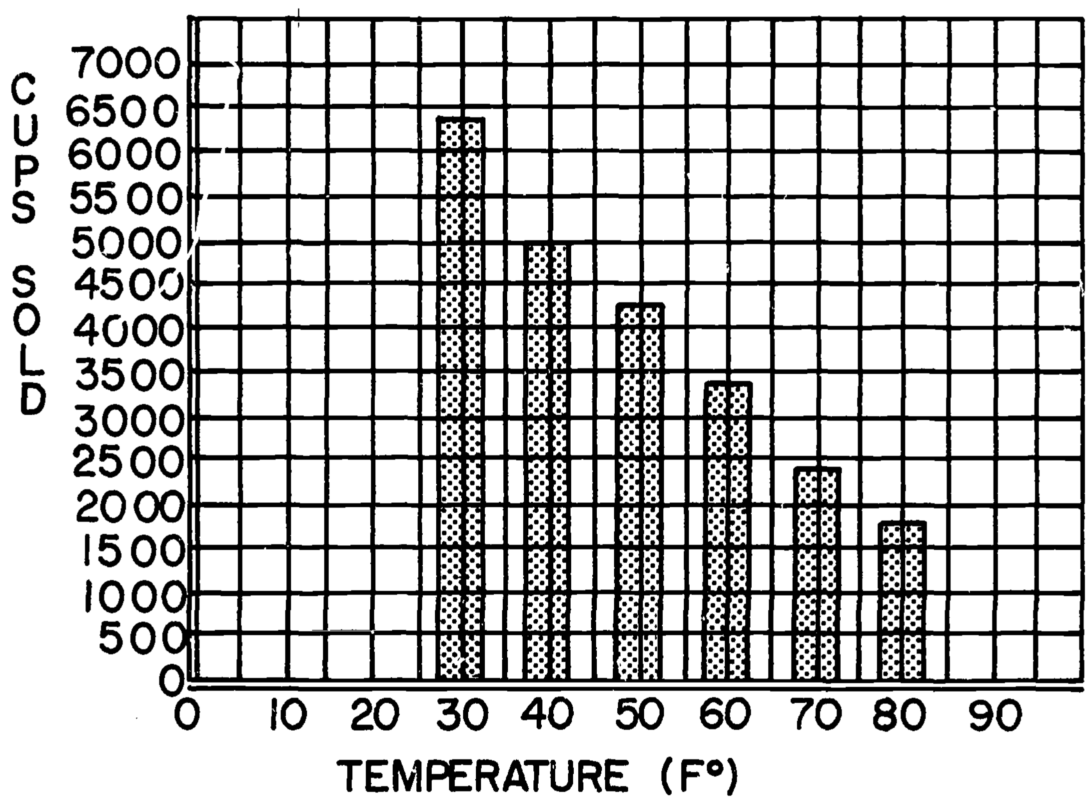
IV. Procedure:

- A. Distribute the student work sheet, "Hot Chocolate At Colt Games."
- B. Have the students read the story and look over the graph.
- C. Discuss the graph
  1. The title
  2. The scale on the horizontal axis
     - (a) shows temperature in degrees
     - (b) is one space equals 5°
  3. The scale on the vertical axis
     - (a) shows the number of cups sold
     - (b) is one space equals 500 cups
  4. The points
     - (a) represent the number of cups sold at a given temperature
     - (b) could be named by ordered pairs: temperature, cups sold
     - (c) indicate particular games. The seven points indicate the seven home games.
- D. Have the students answer the questions given on the work sheet.
- E. Evaluate learning by using work sheet, "Last Year's Sales." Have students answer the questions given on work sheet, "Hot Chocolate At Colt Games."

HOT CHOCOLATE AT COLT GAMES

Tom and Bill were responsible for selling hot chocolate at the Colt home games. At the end of the 1965-66 season they reported the number of cups that were sold at each of the six home games. Tom said that he thought he sold more hot chocolate when the day was cold. The boys wanted to see if the temperature during each game was related to the number of cups sold. They made a graph that would show this information. At each game the stadium was full. The stadium holds about 58, 000 people.

HOT CHOCOLATE SALES



HOT CHOCOLATE AT COLT GAMES

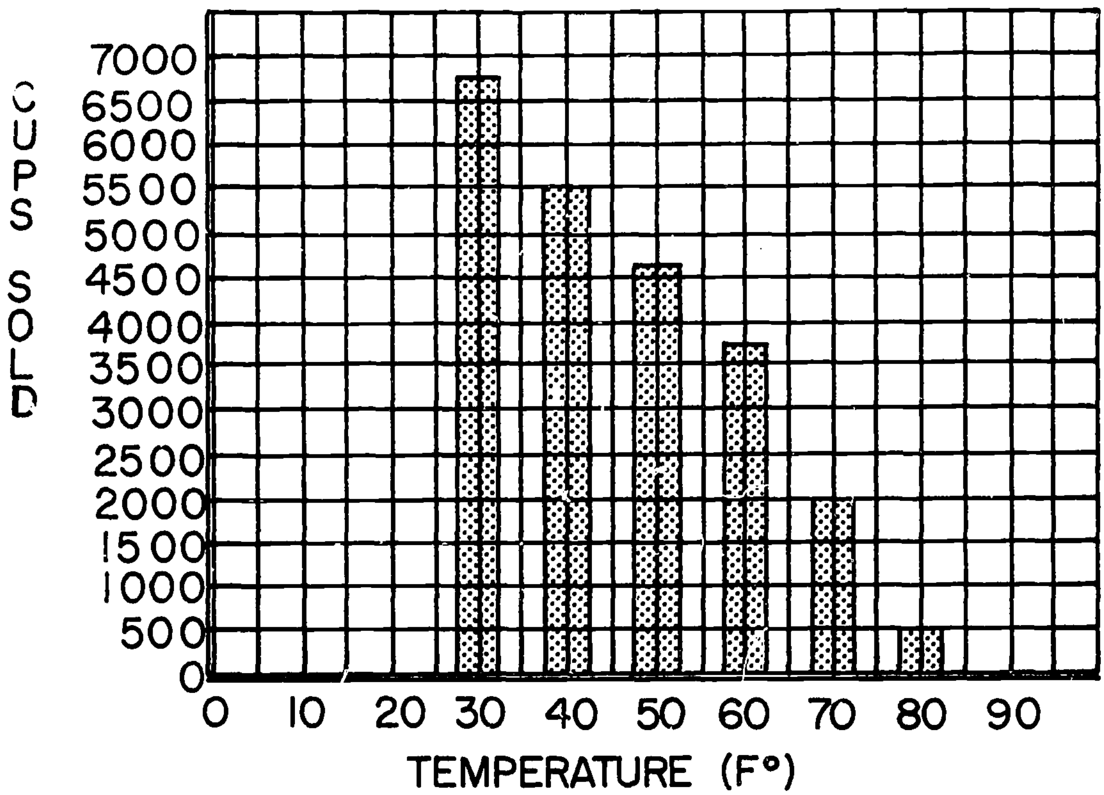
Use the graph to answer the following questions.

1. How many games are included on this graph? ______________
2. What was the coldest temperature at a single game? ______________
3. What was the hottest temperature at a single game? ______________
4. What was the least number of cups of hot chocolate sold at a single game? ______________
5. What was the greatest number of cups of hot chocolate sold at a single game? ______________
6. How many cups were sold when the temperature was 40°? ______________
7. How many cups were sold when the temperature was 50°? ______________
8. How many cups were sold when the temperature was 70°? ______________
9. What was the total number of cups sold at the six games? ______________
10. What seems to happen to the hot chocolate sales as the temperature increases? ______________
11. What do you think would happen to the sales if the temperature went up to 110°? ______________ If the temperature went down to 15°? ______________

LAST YEAR'S SALES

Tom and Bill found a graph of the hot chocolate sales for the year 1964-65. They found it was similar to the 1965-66 graph. The graph they found is shown below.

HOT CHOCOLATE SALES



PROBABILITY AND STATISTICS

PROBABILITY - STATISTICS

I. Master Chart - Grades Six through Eleven

UNIT PROBABILITY GRADE(S) Eight through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Event	8	8	8							
Certainty - Uncertainty	8	8		8	8					
Sample Spaces - Ordered Arrangements	8	8		8	8					8
Equally and Unequally Likely Outcomes	8	8	8			8	8			8
Probability	8	8				10				
Ordered Arrangements (Permutations)	9	9		9	9	9				
Factorial	9	9		9	9		9			
Permutations of N things taken N at a time	9	9		9		9	9			
Permutations of N things taken R at a time	9	9		9		9	9			9
Tree Diagram	9	9		9	9		9			
Box Diagram	9	9		9	9		9			
Decreasing and Increasing Probability	10	10		10		10	10			
Probability of 0 and 1	10	10		10		10	10			
Independent and Dependent Events	10	10		10	10	10	10	10		10
Complementary Events	10	10		10		10	10			
Experimental Probability	10	10	10		10					
Theoretical Probability	10	10			10					10
Sample	11	11	11		11		11	11		11

UNIT PROBABILITY GRADE(S) Eight through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Circular Permutation	11	11		11	11	11	11			
Combination	11	11		11	11					11
Combinations of N things taken N at a time	11	11		11		11				
Combinations of N things taken R at a time	11	11		11	11	11	11			
Preduction	11	11		11	11	11	11			
Chances (Odds)	11	11		11		11	11			11

UNIT STATISTICS GRADE(S) Nine through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Data	9				9				9	
Range	9	9	9		9	9	9			9
Rank	9	9	9		9		9	9		9
Interval	9	9	9			9	9			9
Tally	9	9	9		9		9			
Frequency	9	9	9	9	9					9
Frequency Table	9	9		9	9	9		9		9
Mean	9	9				9	9	9		9
Median	9	9				9	9	9		9
Mode	9	9				9	9	9		9
Pictograph	9	9						9		
Circle Graph	9	9		9				9		
Bar Graph	9	9		9				9		
Line Graph	9	9		9				9		
Normal Curve	10	10		10	10			10		
Pascal's Triangle	10	10	10	10			10	10		
Percentile	10	10		10	10	10	10	10		10
Correlation	11	11			11		11	11		
Scattergram	11	11		11	11	11	11			11

ALGEBRA

ALGEBRA

I. Master Chart - Grades Six through Eleven

II. Grade Seven Chart

III. Behavioral Objectives

IV. Activities

UNIT ALGEBRA GRADE(S) Six through Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Set	6, 8	6, 8		6	6					6
Member	6, 7	6, 7			6					6
Types of Sets	6, 7	6, 7		6	6, 7					6, 7
Relationship Between Sets	6, 8, 9	6, 8, 9		6, 8	6, 8					6, 8
Methods of Describing Sets	6	6			6					6
Operations With Sets	6	6			6					6
Language of Algebra	6, 7, 8 9, 10	6, 7, 8, 9 10		9	7, 8, 9	7			9	6, 7, 8, 9
Symbols for Operations	6, 7, 8	6, 7, 8, 9	6	8, 9	9					6, 7, 8
Symbols for Grouping	6, 10	6, 10	6, 7	10		6, 7, 9, 10	6, 7, 9, 10		10	6, 10
Evaluating Algebraic Expressions			9, 10, 11	10, 11	9, 10, 11	9, 10, 11	9, 10, 11			
Number Line	8, 9	8, 9	9	8, 9		9	9		8, 9	9
Operations With Rationals	9, 10	9, 10	10	9	9	9, 10	9, 10			9
Similar Terms	10, 11	10, 11	10, 11		10, 11	10, 11	10, 11			10, 11
Open Sentences With One Operation			9	9		9	9			
Open Sentences With Combined Operations	9, 11	9, 11	9, 11		9, 11					
Inequalities With One Operation	9	9	9		9					9
Inequalities With Combined Operations	11	11			11	11	11			11
Rationals	9	9		9	9				9	9

UNIT ALGEBRA GRADE(S) Seven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Member	7	7								
Universal Set	7	7			7					7
Factor	7	7			7					7
Exponent of Two	7	7				7				7
Base	7	7			7					7
Symbols of Multiplication	7	7								7
Order of Operation No Symbols of Grouping			7			7	7			

ALGEBRA - Grade 7

Page

<u>Member</u>

The student should be able to:

1. Name and identify the symbol ($\in$) for member of a set

<u>Universal Set</u>

The student should be able to:

1. Name and identify the symbol (U) for universal set
2. Describe a universal set by definition or through specific examples
3. Distinguish between a universal set and its subsets

<u>Factor</u>

The student should be able to:

1. Name and identify factors
2. Describe a factor by definition or through specific examples
3. Distinguish between numbers used as factors and those used as addends

<u>Exponent of Two</u>

The student should be able to:

1. Name and identify an exponent of 2
2. State the principle that the exponent 2 means that the base is used as a factor twice
3. Distinguish between the numeral "two" used as an exponent and as a factor

<u>Base</u>

The student should be able to:

1. Name and identify base
2. Describe the base as the number which is used as a factor

Page

3. Distinguish the base from the exponent

Symbol for Multiplication

The student should be able to:

1. Name and identify the symbol dot (·) for multiplication
2. Distinguish the dot from the decimal point

Problems Involving Order of Operations With No Grouping Symbols

The student should be able to:

1. State and apply the principle that in an expression without symbols the operations are performed accordingly: multiplication or division, left to right, followed by addition or subtraction, left to right
2. Demonstrate how to use the order of operations with no symbols of grouping

LOGIC

LOGIC

I. Master Chart - Grades Six through Eleven

UNIT LOGIC GRADE(S) Ten and Eleven

TOPIC	NAME	IDENTIFY	DEMON-STRATE	CONSTRUCT	DESCRIBE	STATE THE PRINCIPLE	APPLY THE PRINCIPLE	INTERPRET	ORDER	DISTIN-GUISHING
Equivalent Phrases and Sentences	10	10		10						8, 10
Assumptions	10	10		11	10					10
"If - Then" Statements	10, 11	10, 11		10				10		10, 11
Converse	11	11		11	11	11		11		11
Inverse	11	11		11	11	11		11		11
Circular Reasoning (Doubletalk)										11
Valid Arguments					10, 11					10, 11
Non-Valid Arguments					10, 11					10, 11
Syllogism (Chain of Logic)										11
Indirect Proof						11	11			
Venn Diagrams	10	10						10		
Open Sentences	8, 10	8, 10		8, 10	8, 10					8, 10
Closed Sentences	8, 10	8, 10		8, 10	8, 10					8, 10
Deductive Reasoning					11					11
Inductive Reasoning					11					11
Counterexample				10	10	10	10			

RECREATIONAL ACTIVITIES

RECREATIONAL ACTIVITIES

The units contained in this section are supplementary activities for recreation. These may be used to provide variety throughout the year as well as in the daily lesson.

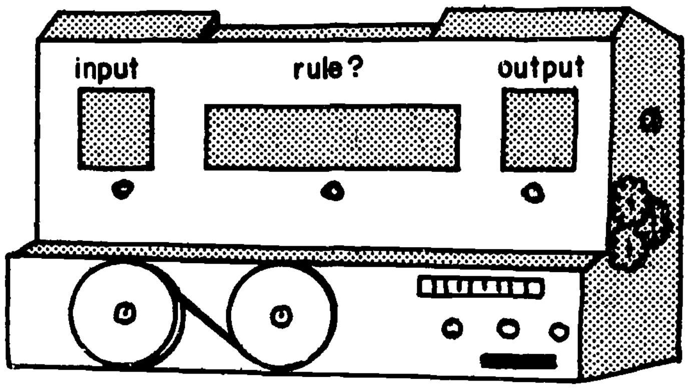
THE FUNCTION MACHINE

Teacher Commentary

A Recreational Activity on Fundamental Operations

I. Materials:

A. Drawing, model or overhead projectual of a function machine similar to one drawn below.



B. Student work sheet entitled "The Function Machine"

II. .ocedure:

A. Play the game "What's My Rule?" to prepare students for work with the function machine.

1. The student gives the teacher a number.

2. Using a rule, such as "multiply by two," the teacher gives back a number after she has applied the rule.

3. Students continue to give the teacher numbers and listen to her responses until they are able to guess the rule.

B. Show the function machine and discuss how it works.

1. As in the game "What's My Rule?" a number is put into the maching at the Input box. Students may suggest numbers or the teacher may have some planned.

2. A number then appears in the Output box according to an unknown rule.

3. This continues until the students guess the rule. So that one student does not reveal the rule to the rest of the class, he may run the machine to prove he knows the rule without actually telling it.

C. The function machine may be used as a quick drill or game at the beginning or end of a class period. Many different rules may be used. Students may be asked to think of their own rules for the function machine.

D. Some suggested rules are:

Add 10

Input	Output
14	24
17	27
28	38
32	42
27	37
48	58

Add 8

Input	Output
5	13
9	17
15	23
29	37
58	66
24	32

Multiply by 10

Input	Output
7	70
6	60
12	120
27	270
48	480

Multiply by Itself

Input	Output
4	16
3	9
6	36
7	49
8	64

Divide by 8	
Input	Output
24	3
64	8
320	40
400	50
480	60

Divide by 7	
Input	Output
28	4
49	7
630	90
420	60
350	50

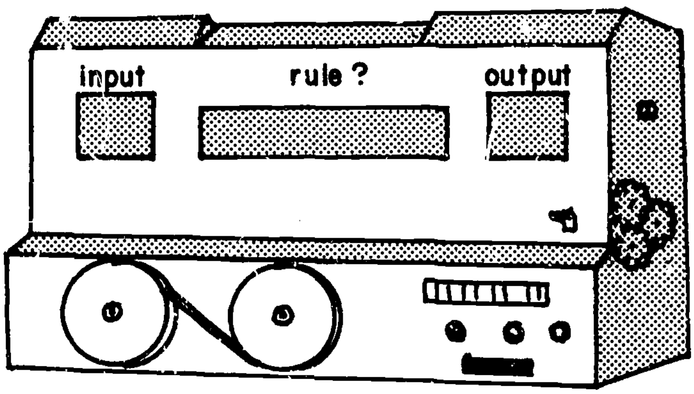
E. Variations of this function machine game:

1. Give the students the rule and the input number and have them tell the output number.

2. Give the students the rule and the outpout number and have them tell the input number.

F. The student work sheet "The Function Machine" may be used as an independent activity. It is designed so the teacher may fill in the rules or numerals she wants to use with her class.

THE FUNCTION MACHINE



Rule

Input		Output
	→	
	→	
	→	
	→	
	→	

Rule

Input		Output
	→	
	→	
	→	
	→	
	→	

Rule

Input		Output
	→	
	→	
	→	
	→	
	→	

Rule

Input		Output
	→	
	→	
	→	
	→	
	→	

Rule

Input		Output
	→	
	→	
	→	
	→	
	→	

Rule

Input		Output
	→	
	→	
	→	
	→	
	→	

THE NEW TIC-TAC-TOE

Teacher Commentary

A Recreational Activity on Addition of Whole Numbers

I. Materials: Paper and pencil

II. Procedure:

This game is played by two people using the ordinary tic-tac-toe diagram. The players take turns alternately. When it is his turn a player chooses one of the digits 1-9. Each digit can be used only once. Place it in any unfilled cell of the diagram.

The player's goal is to make the sum of three digits in any row, column, or diagonal equal to 15.

The player who first makes the sum of three digits in any row, column, or diagonal something other than 15 loses the game.

IT'S BASEBALL TIME

Teacher Commentary

A Recreational Activity on Fundamental Operations

I. Materials:

A. Poster paper for:

1. Flash cards
2. Color wheel

B. Chalkboard for drawing:

1. Make-believe ball field
2. Score board

II. Procedure:

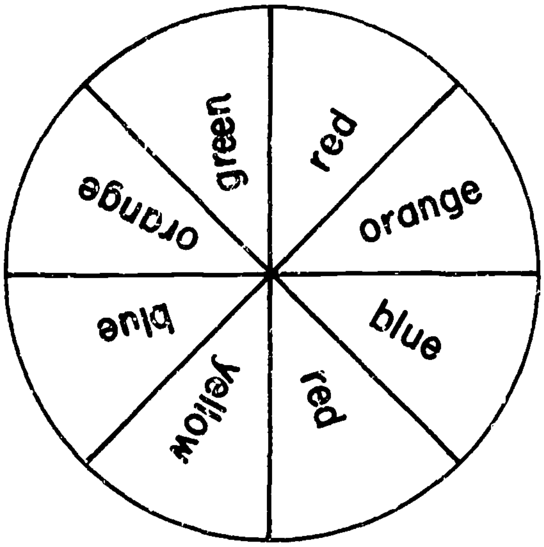
A. Construct flash cards from poster paper. These cards would consist of basic addition facts and multiplication facts with inverse operations included.

1. Examples:

$$\begin{array}{r} 5 \\ +\square \\ \hline 7 \end{array} \qquad \begin{array}{r} 6 \\ \times \triangle \\ \hline 42 \end{array} \qquad \begin{array}{r} \square \\ \times \;\; 5 \\ \hline 45 \end{array} \qquad \begin{array}{r} 15 \\ - \triangle \\ \hline 7 \end{array} \qquad 18 \div \square = 9$$

2. Examples become more difficult as the year progresses. More difficult flash card involves fractions, decimals, percent, and others.

B. Construct a color wheel large enough to be seen by the entire class.



Code:

Red - Single

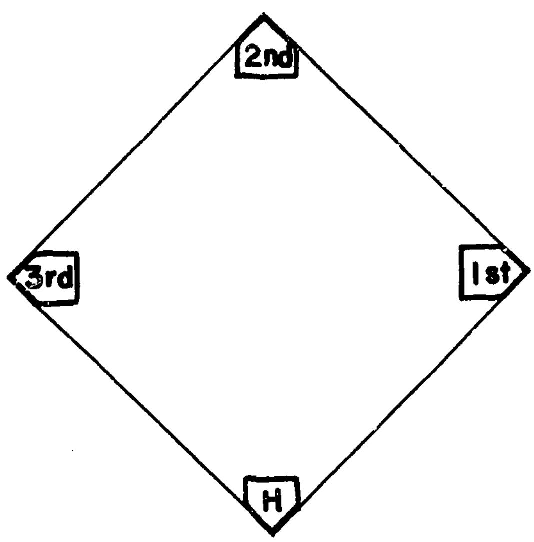
Blue - Double

Green - Triple

Yellow - Home Run

Orange - Out!!

C. Draw a make-believe ball field on the chalkboard.



(Note: The ball field and score board could be placed on very large tag board instead of the chalkboard.)

D. Draw the following score board on the chalkboard.

INNING	1	2	3	4	5	6	7	8	9	Total
Team I										
Team II										

E. Select three officials whose duties are:

1. Spin the color wheel to determine the type of hit the batter will attempt to make.
2. Pick out the appropriate flash card for the batter.
3. Keep tally of runs and positions of men on base.

F. Divide the class, not including the officials, into two teams. A coin may be tossed to see who "bats" first.

G. Play begins when the official spins the color wheel. The next official flashes the card. If the player answers it correctly, he takes the base designated by the type of hit he had shown on the color wheel.

H. Official three keeps a tally of all scores, signals to change sides when there are three outs, and stops the game at the end of a designated time period.

You may want to make this a 5 inning or 7 inning game depending upon the alloted time.

CALENDAR MAGIC

Teacher Commentary

A Recreational Activity on Addition and Multiplication of Whole Numbers

I. Materials:

A. Calendar

B. Pencil

C. Paper

II. Procedure:

<u>Activity I</u>

SUN.	MON.	TUES.	WED.	THURS.	FRI.	SAT.
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

1. Choose a block of 9 days
2. Add the middle column of dates, $10 + 17 + 24 = 51$
3. Add a diagonal, $9 + 17 + 25 = 51$
4. Add the other diagonal, $23 + 17 + 11 = 51$
5. Multiply the center date by 3, $3 \times 17 = 51$
6. Work out other blocks of 9 days
7. Can you figure out why it works?

Activity II

Magic Eleven

3	4	5
10	11	12
17	18	19

1. Choose the 9 dates on a calendar in which the rows, columns, and diagonals pass through 11.
2. Add the middle row, 10 + 11 + 12 = 33
3. Add the middle column, 4 + 11 + 18 = 33
4. Add each diagonal, 3 + 11 + 19 = 33, 17 + 11 + 5 = 33

Activity III

Lightning Addition

Have students add the dates at any given full week on the calendar as fast as they can. It is possible to get the sum "lightning fast" by:

1. Choosing the date of Wednesday of that week.
2. Multiplying this number by seven.

FIND THOSE NUMERALS!

Teacher Commentary

A Recreational Activity on Fundamental Operations

I. Materials:

A. Work sheet, "Find Those Numerals!"

B. Pencils

C. Paper

II. Procedure:

A. Distribute work sheet entitled "Find Those Numerals!" to students.

B. Have students read directions carefully.

C. Clarify any parts not understood.

D. Complete the work sheet by selecting numerals from the top to complete each equation in the chart.

Solution:

x	25	4	12	$7\frac{1}{2}$	50
y	15	$1\frac{1}{2}$	6	$\frac{1}{4}$	25
$x + y$	40	$5\frac{1}{2}$	18	$7\frac{3}{4}$	75
$x - y$	10	$2\frac{1}{2}$	6	$7\frac{1}{4}$	25
$x \cdot y$	375	6	72	$1\frac{7}{8}$	1250
$x \div y$	$1\frac{2}{3}$	$2\frac{2}{3}$	2	30	2

FIND THOSE NUMERALS!

Directions: Decide where each number belongs in this number puzzle so that each equation is a true one.

75 $1\frac{1}{2}$ 40 30 12 10 $1\frac{2}{3}$ $1\frac{7}{8}$

6 2 375 $5\frac{1}{2}$ 6

$\frac{1}{4}$ 72 $2\frac{2}{3}$ 25 2 $7\frac{1}{4}$ 50

X=	25	4		$7\frac{1}{2}$	
Y=	15		6		25
X+Y=			18	$7\frac{3}{4}$	
X−Y=		$2\frac{1}{2}$			
X·Y=					1250
X÷Y=					

MAGIC WHEEL

Teacher Commentary

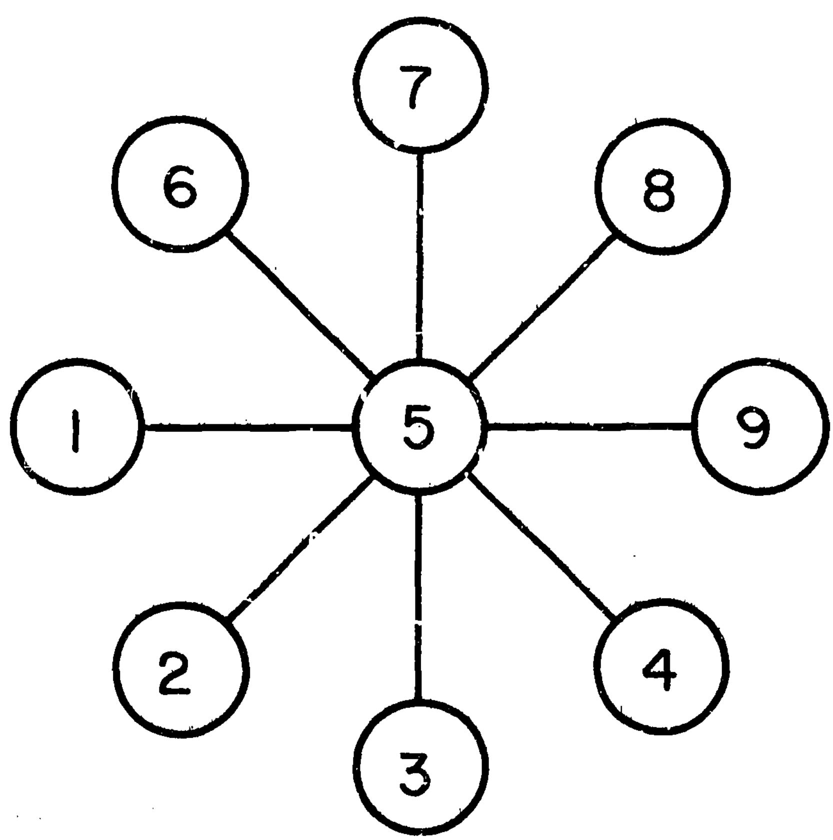
A Recreational Activity on Addition of Whole Numbers

I. Materials: Student work sheet entitled, "Magic Wheel"

II. Procedure:

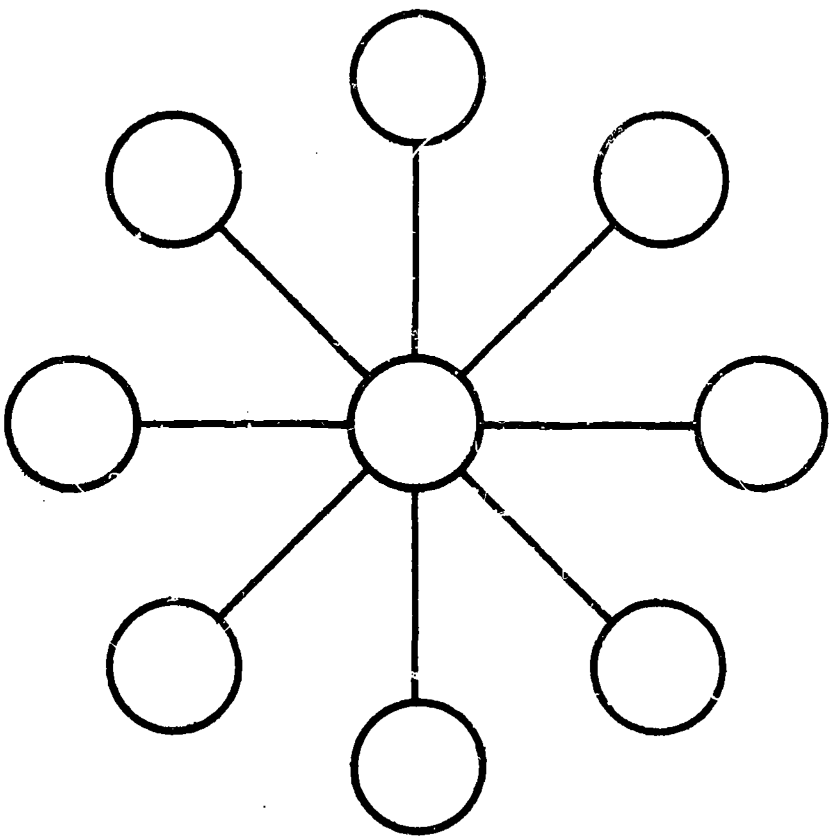
Puzzle may be used as a recreational activity at the end of the period.

Solution



MAGIC WHEEL

Arrange the nine digits in the circles below so that the sum on any diameter is 15.



PATTERNS

Teacher Commentary

A Recreational Activity on Multiplication Patterns

I. Materials: Attached sheet to be duplicated

II. Procedure:

A. Distribute duplicated copies of the multiplication array.

B. Have students contribute, orally, patterns they notice in this array.

C. Some of the patterns to be found are:

1. Additive and subtractive patterns
2. Squaring patterns
3. Multiplicative patterns
4. Patterns related to binomial pattern
5. Role of 0 and 1

PATTERNS

X	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

CROSS NUMBER PUZZLES

Teacher Commentary

A Recreational Activity on Fundamental Operations

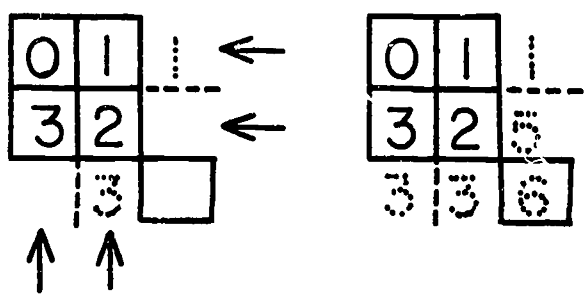
I. Materials: Student work sheet entitled, "Cross Number Puzzles"

II. Procedure:

A. How to do the puzzles:

1. In the spaces indicated by the arrows, write the answer to the two numbers in that column or row.

   Example: Addition



2. The box at the lower right hand corner is a check.

B. When to use cross number puzzles:

1. As a short drill for the entire class.
2. As a homework assignment, (since the problems are self-checking).
3. For individual pupils who have finished their assignment.
4. For a small group while the teacher instructs the remainder of the class in other matters.

C. Use of example ditto sheets:

Several examples of cross number puzzles are given on the following pages. These examples may serve as a basis for teacher made work sheets.

B. Check work sheets with class.

Solution: Addition of Fractions

1/2	1/2	1
1/2	1/2	1
1	1	2

1/8	1/2	5/8
1/8	1/4	3/8
2/8	3/4	1

3/4	1/4	4/4
1/2	1/8	5/8
5/4	3/8	1 5/8

1/3	1/6	3/6
1/3	1/6	3/6
2/3	1/3	1

1/10	1/10	2/10
3/10	4/10	7/10
4/10	5/10	9/10

1/5	1/5	2/5
3/10	1/10	4/10
5/10	3/10	8/10

2/3	1/6	5/6
1/3	5/6	7/6
1	1	2

3/4	1/8	7/8
1/2	1 1/8	1 5/8
1 1/4	1 2/8	2 1/2

5/6	2/3	1 1/2
1/3	1 1/3	1 2/3
1 1/6	2	3 1/6

Solution: Addition of Decimals

1.2	.5	1.7
.3	.2	.5
1.5	.7	2.2

2.1	.8	2.9
.3	.3	.6
2.4	1.1	3.5

1.2	3.3	4.5
.3	.7	1
1.5	4	5.5

3.5	2.5	6
.5	1.5	2
4	4	8

1.4	2.6	4.0
.1	.9	1.0
1.5	3.5	5.0

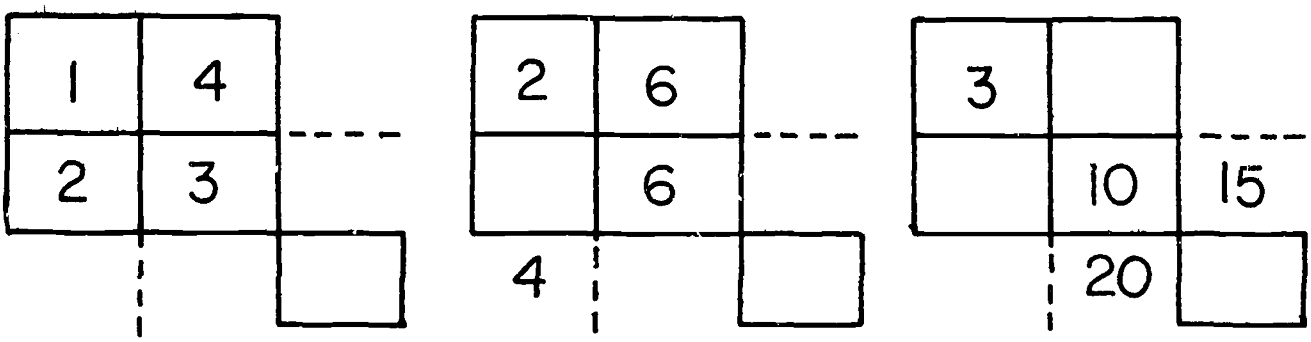
1.7	2.5	4.2
.2	.7	.9
1.9	3.2	5.1

.1	.9	1
.5	.5	1
.6	1.4	2

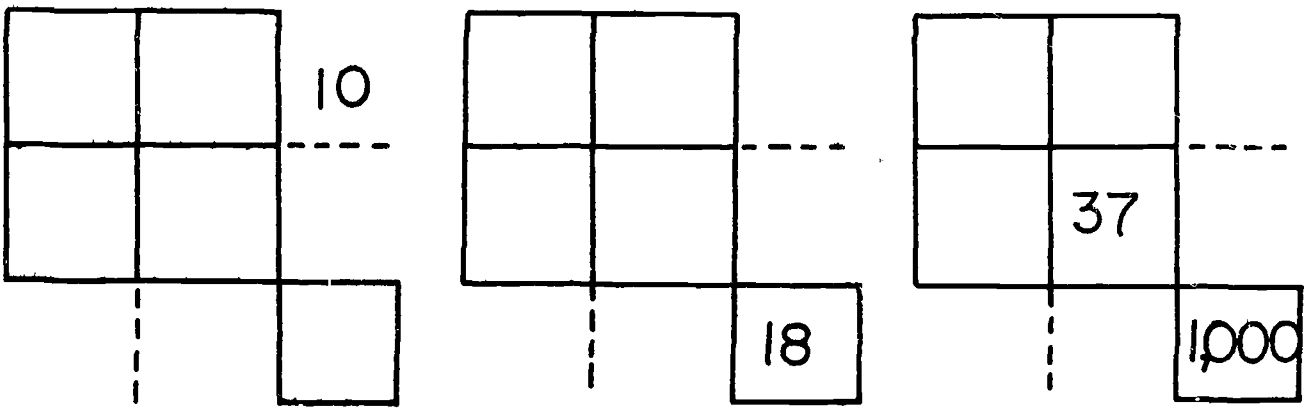
2.0	2.6	4.6
1.4	1.0	2.4
3.4	3.6	7.0

1.3	.2	1.5
1.7	.9	2.6
3.0	1.1	4.1

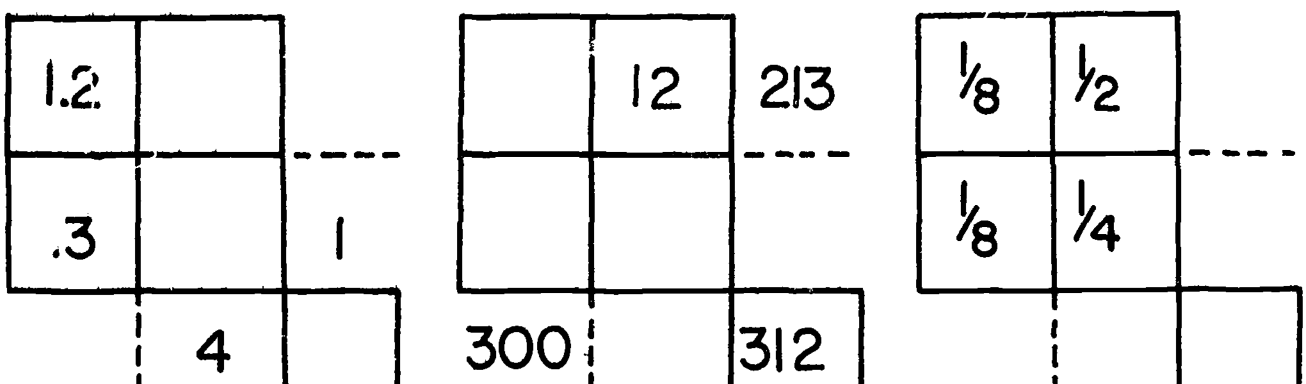
CROSS NUMBER PUZZLES - EXAMPLES OF ADDITION



MAKE YOUR OWN



HOW MANY WAYS CAN
YOU COMPLETE THIS?



CROSS NUMBER PUZZLES - EXAMPLES OF SUBTRACTION

MAKE UP YOUR OWN

20	10	10
6	3	
	7	7

17	7	
9	4	

		8

	7	6
4	2	

	8	7
	0	0

110	65	
90	46	

$\frac{3}{4}$	$\frac{1}{4}$	
$\frac{1}{2}$	$\frac{1}{8}$	

.9	.5	
.6	.4	

$1\frac{1}{3}$	$\frac{2}{3}$	
$\frac{1}{2}$	$\frac{1}{6}$	

CROSS NUMBER PUZZLES - EXAMPLES OF DIVISION

16	4	4
8	4	
2	1	2

72	9	
6	3	

		3
9	3	
	2	

24		
	2	
	4	1/2

MAKE UP ONE WHICH WORKS

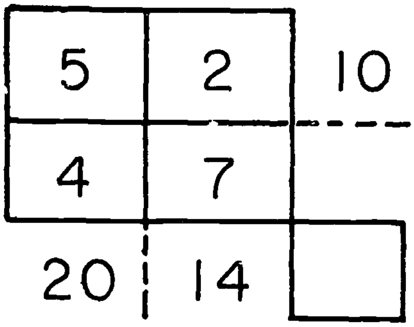
MAKE UP ONE WHICH DOES NOT WORK

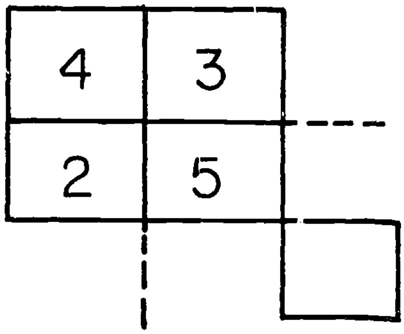
$3\overline{)18}$	$4\overline{)16}$	
18	$5\overline{)15}$	

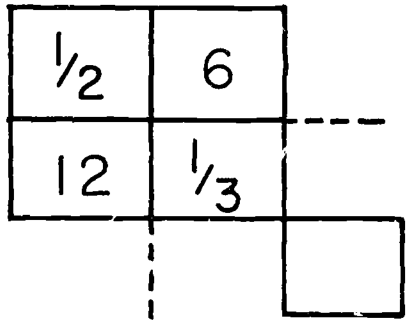
4	1/2	
	4	
8		

.4	20	
100	2	

CROSS NUMBER PUZZLES - EXAMPLES OF MULTIPLICATION

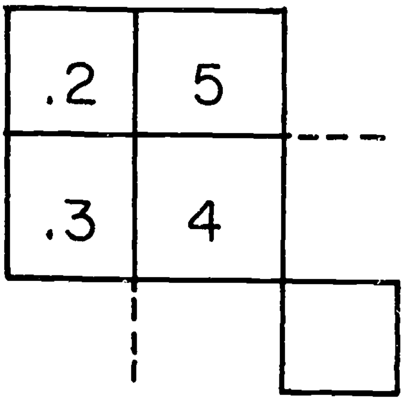


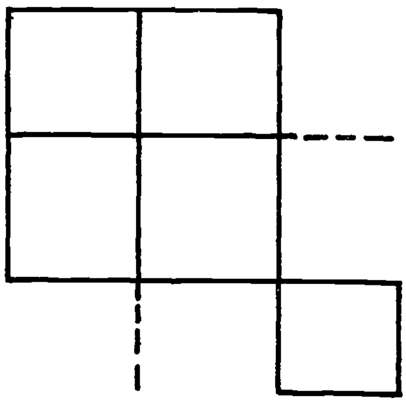


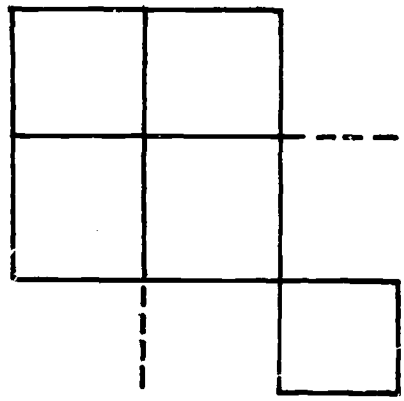


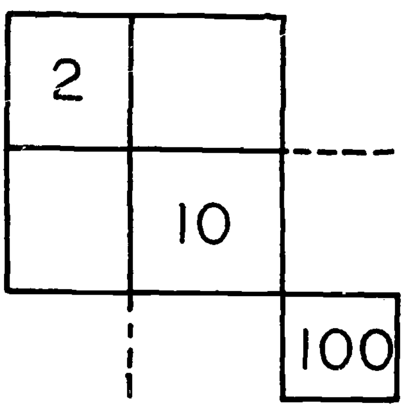
MAKE UP AN EXAMPLE
WHICH WORKS

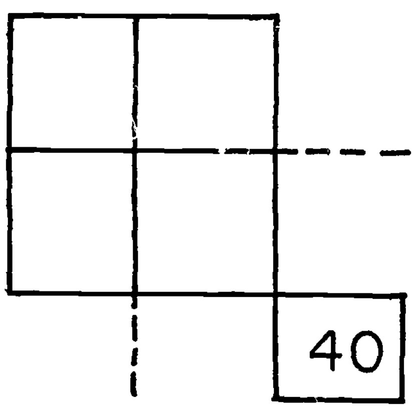
MAKE UP AN EXAMPLE
WHICH DOES NOT WORK

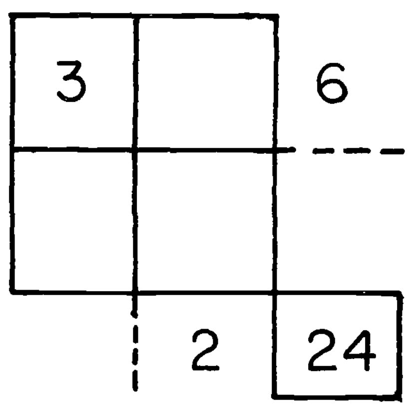












CROSS NUMBER PUZZLE - ADDITION OF FRACTIONS

1/2	1/2	
		1
		2

1/8	1/2	
1/8	1/4	

3/4	1/4	
1/2	1/8	

1/3	1/6	
		3/6
2/3		

		2/10
		7/10
		9/10

1/5		2/5
3/10		4/10
		8/10

2/3		5/6
	5/6	
1		

	1/8	7/8
	1 1/8	1 5/8

5/6	2/3	
1/3	1 1/3	

CROSS NUMBER PUZZLE - ADDITION OF DECIMALS

1.2	.5	
.3	.2	

2.1	.8	
	.3	.6

1.2		
.3		1
	4	

3.5	2.5	
		2
4		8

1.4		4.0
	.9	1.0
	3.5	5.0

1.7	2.5	
		.9
	3.2	

.1		1
.5		1

	2.6	
1.4		2.4
		7.0

1.3		1.5
		2.6
3.0		

CLASSROOM MOBILES

Teacher Commentary

A Recreational Activity on Geometry in Art

I. Materials:

   A. Ordinary brown wrapping paper

   B. Scissors

   C. String

   D. Ruler

   E. Dittos showing construction models

II. Procedure:

   A. Let each pupil work independently - do one model at a time.

   B. Encourage attempts to make other models of different designs after completing the required ones.

Bibliography

Hughes, Toni. How To Make Shapes In Space. New York: E. P. Dutton and Co., Inc. 1955

Johnson, Pauline. Creating With Paper. Washington: University of Washington Press. 1958

I. THE PLEAT

Directions:

1. Use a piece of paper 30" x 10". (Step #1)

2. Pleat it by using a ruler on opposite sides as you fold. See Step 2 of the diagram.

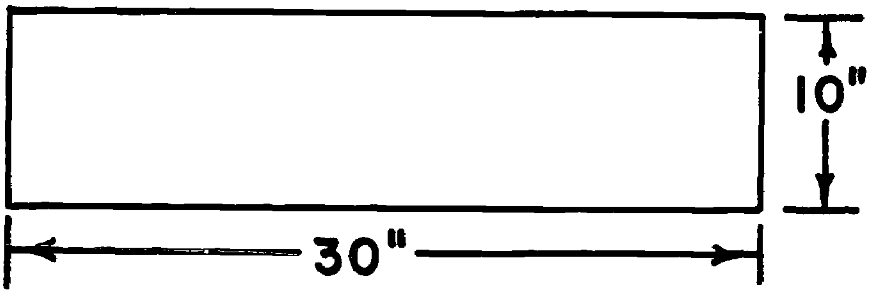
3. Punch a hole through all the pleats at one end. Fasten.

4. Fan out the other end. (Step #3)

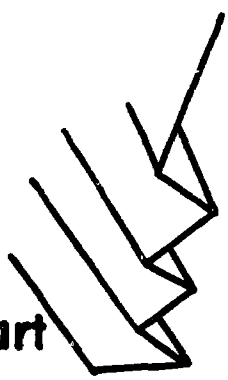
5. Hang it up.

THE PLEAT

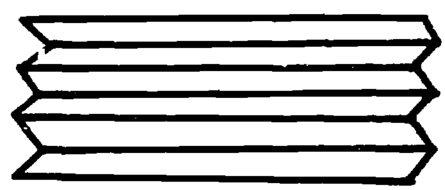
Step 1



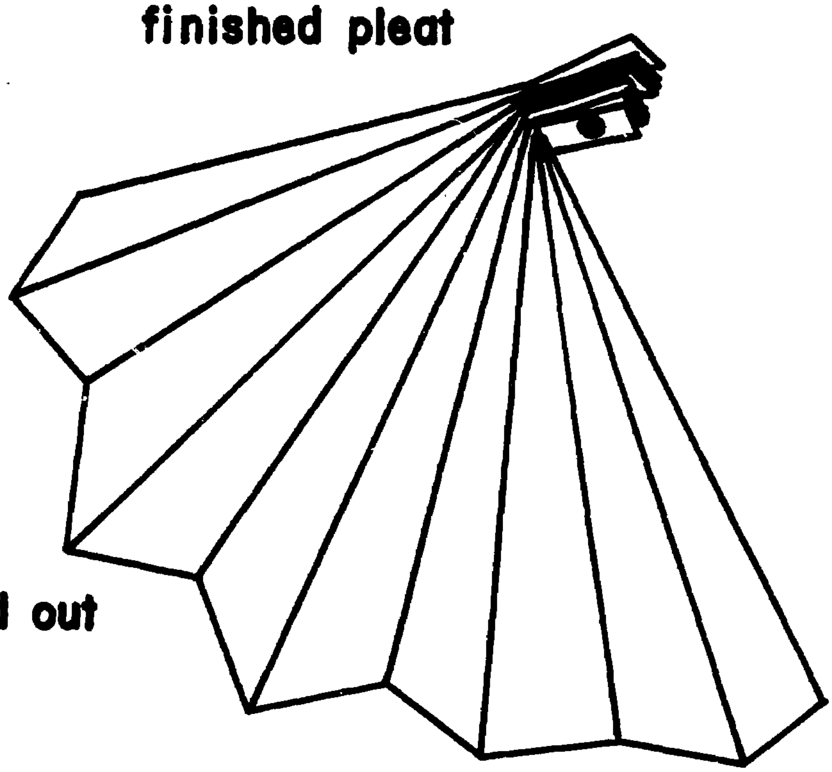
Step 2



start



finished pleat



Step 3

fanned out

II. ONE CONTINUOUS CUT

Directions:

1. Draw a circle with an 8" diameter. (Step #1)

2. Cut it out.

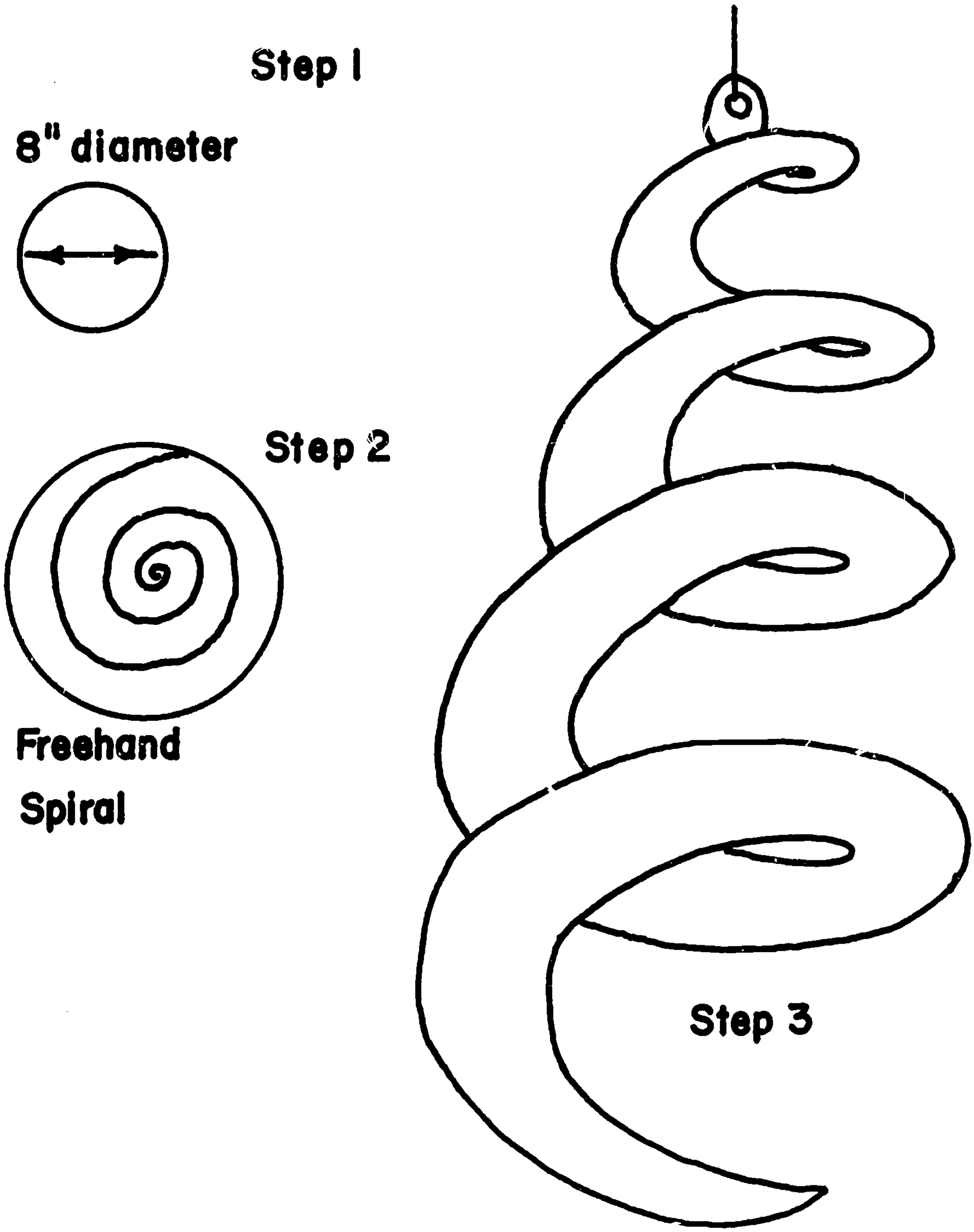
3. Draw a spiral inside the circle as in hopscotch. Draw the spiral freehand. Look at the diagram (Step #2) to see how it should be drawn.

4. Using scissors cut along the spiral line.

5. Punch a hole at the small end of the spiral.

6. Loop doubled string through hole and hang it up. (Step #3)
   (Try some other ways of making an object out of a sheet by use of a continuous cut.)

ONE CONTINUOUS CUT



III. JACOB'S LADDER

Directions:

1. Draw a rectangle 5" x 7". Fold it in half. (See Step #1)

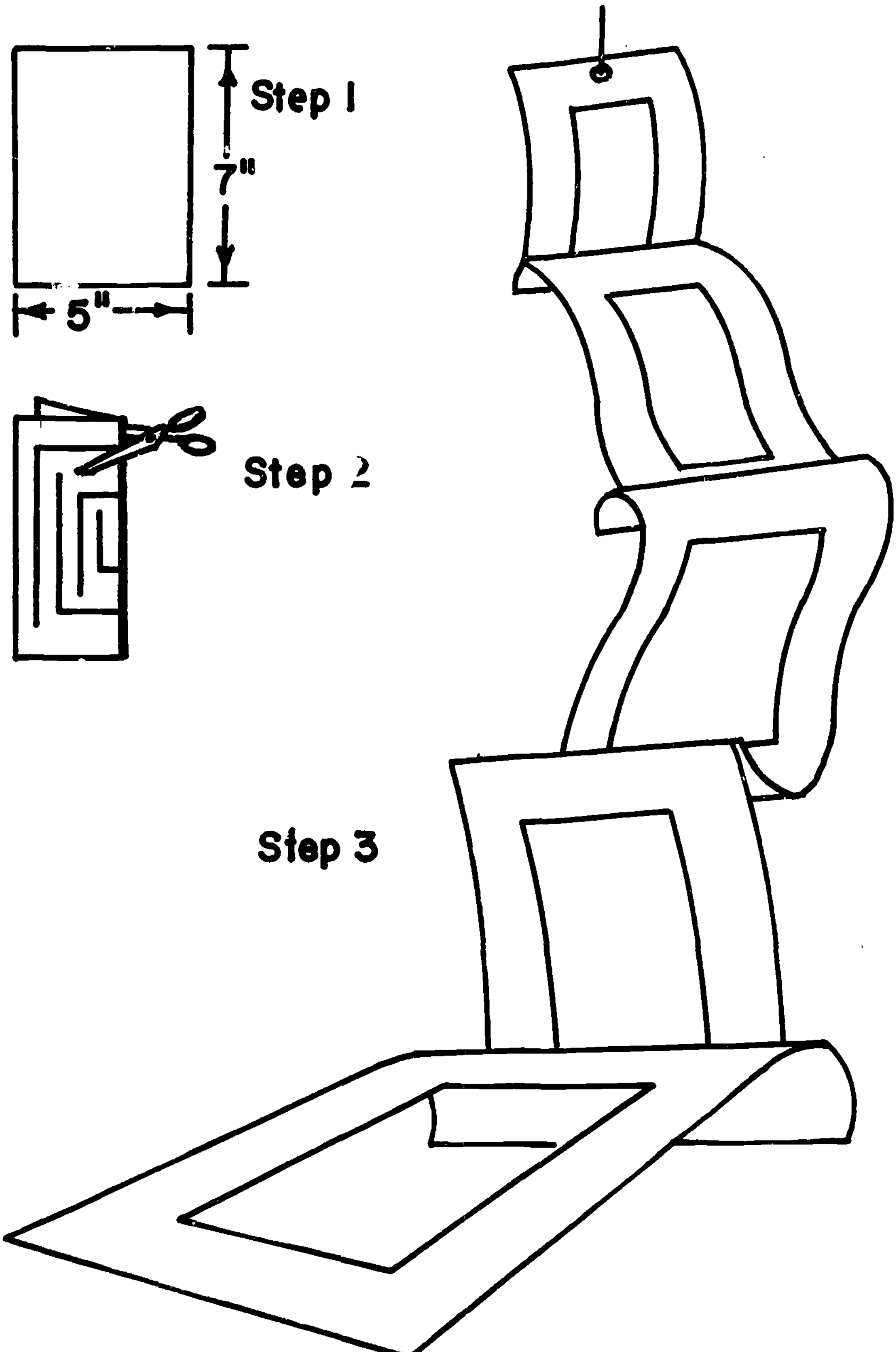
2. Draw lines on one side as indicated in diagram #2.

3. Cut along these lines and unfold.

4. Punch a hole in the free end of the smallest rectangle.

5. Smooth out the center creases and hang it up. (Step #3)
   (You can use the same steps using curved cuts rather than straight cuts.)

JACOB'S LADDER



IV. TAKE AWAY

Directions:

1. Use a piece of paper 9" x 12".

2. Shade areas 1 and 2. (See Step #1) Cut out these areas.

3. Shade areas 3 and 4. (See Step #2) Cut out these areas.

4. Mark corners A, B, C, D as indicated in Step #2.

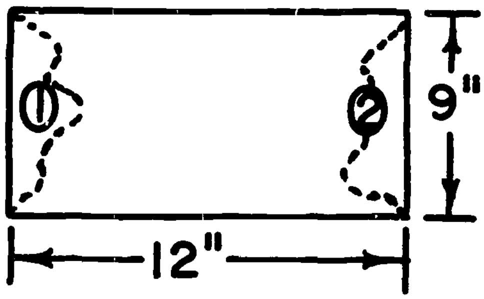
5. Fold A and D together and fasten.

6. Fold C and B together and fasten.

7. Punch holes at CB and hang up. (Step #3)

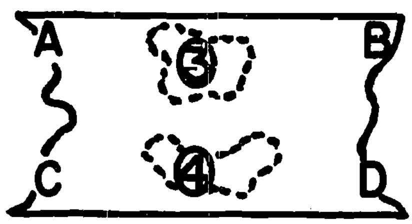
TAKE-AWAY

Step 1



cut irregular ends at ① & ②

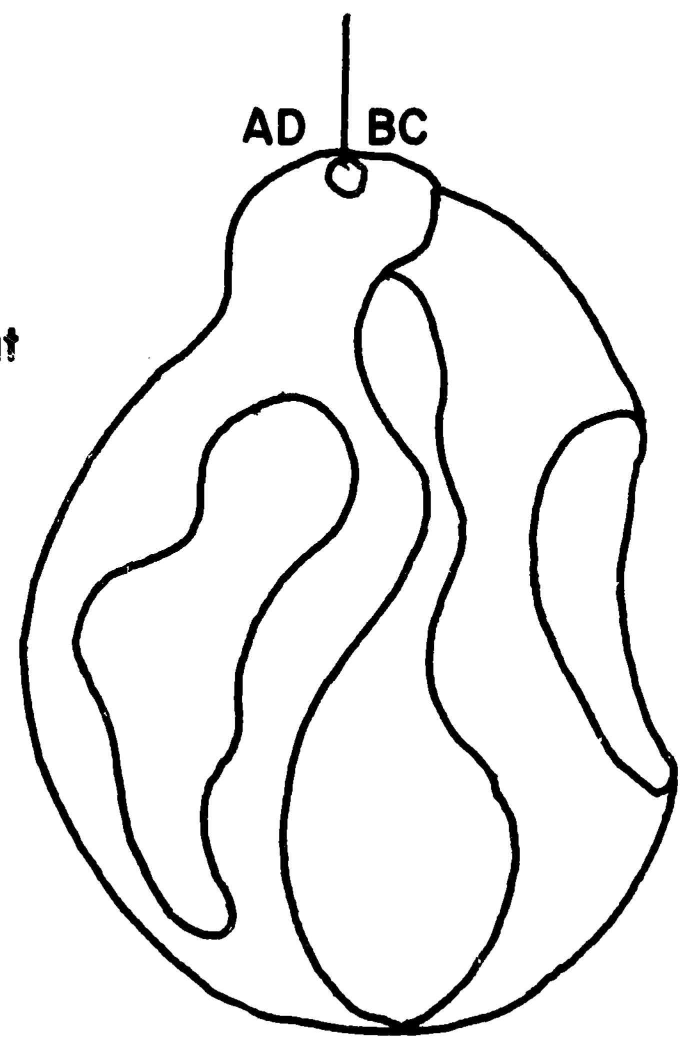
Step 2



cut irregular holes at
③ & ④
mark A,B,C,& D

Step 3

connect A & D
connect B & C



WHAT AM I?

Teacher Commentary

A Recreational Activity on Geometry

I. Materials:

A. Work sheet entitled, "What Am I?"

B. Pencils

II. Procedure:

A. Distribute work sheets entitled, "What Am I?"

B. Have directions read silently.

C. Have students complete the work sheets by identifying the subject named in the riddle.

Solution:

1. plane
2. segment
3. angle
4. parallel lines
5. midpoint
6. square
7. circle
8. simple closed path
9. triangle

WHAT AM I?

Directions: Read each riddle below. On the line below each riddle, write correctly the name that identifies it.

1. I am flat. I have no thickness. I extend on and on into space because I have no boundaries. What am I? ____________

2. I am a part of a line. I have two endpoints. If you write my name it will be AB. What am I? ____________

3. When two rays meet at a point, I am formed. I have many relatives. Some are large, some are small, and some are what we might call a square corner. If you write about me, my name will look like this: $\angle$ ABC. What am I? ____________

4. We are twins, but we never meet. We never intersect each other, but we are in the same plane. No matter how much we grow, we are always the same distance apart. What are we? ____________

5. I am a line segment. But I think something is going to happen to me. A mark was placed right in the middle of me. What is that mark called? ____________

6. I am a four sided figure. All of my sides have the same length. All of my angles are right angles. I have many cousins. You see many examples of me every day - wherever you go. What am I? ____________

7. I am made of many points that are all the same distance from my center point. I have a diameter. Oh, and I have a radius, too. You see many of me everyday, also. What am I? ____________

8. I am simple. If you start at a given point on me and continue in my path, you will return to the point from which you started. I never cross myself at any time. What am I? ____________________

9. I have three sides. I also have three angles. These may or may not be the same size depending upon my shape and size. What am I?

____

PERIMETER PUZZLE

Teacher Commentary

A Recreational Activity on Perimeter

I. Materials:

Work sheet "Perimeter Puzzle"

II. Procedure:

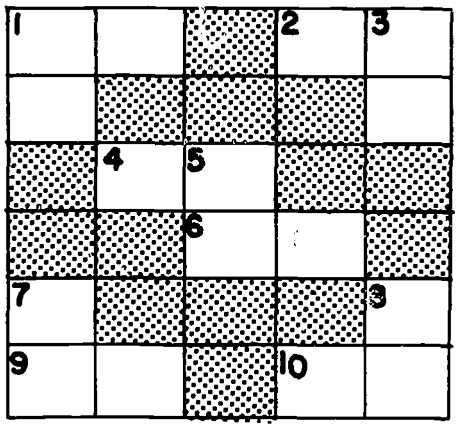
A. Distribute work sheet and briefly discuss procedure for working this type of cross number puzzle.

B. Permit students to work puzzle.

Solution:

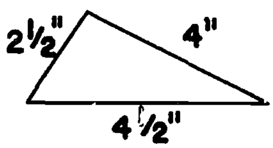
[1] 1	2	■	[2] 3	[3] 6
6	■	■	■	4
■	[4] 1	[5] 1	■	■
■	■	[6] 2	3	■
[7] 1	■	■	■	[8] 4
[9] 4	8	■	[10] 6	0

PERIMETER PUZZLE

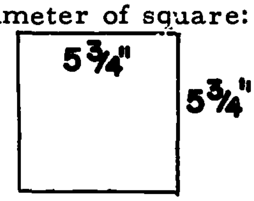


Across

1. Number of inches in one foot
2. Number of inches in one yard
4. Perimeter of triangle:



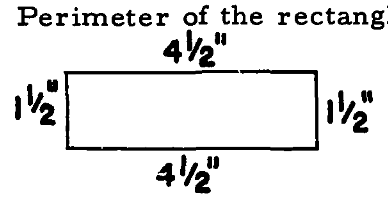
6. Perimeter of square:



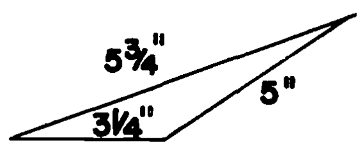
9. Four feet = ____ inches
10. Number of minutes in one hour

Down

1. Number of ounces in one pound
3. Perimeter of a square 16 inches on each side
5. Perimeter of the rectangle:



7. Perimeter of triangle:



8. Perimeter of rectangle with length of 15 $\frac{1}{2}$ inches and width of 4 $\frac{1}{2}$ inches

THE LONG AND SHORT OF IT - PUZZLE II

Teacher Commentary

A Recreational Activity on Measuring Line Segments
and Adding and Subtracting Fractions

I. Materials:

A. Ruler

B. Student work sheet entitled "The Long and Short of It - Puzzle II"

II. Procedure:

A. Distribute work sheet entitled "The Long and Short of It - Puzzle II"

B. Make certain students understand the directions.

C. Work the sample exercises.

D. Permit students to work through the activity.

Solutions:

A. $\frac{1}{2}$"

B. $\frac{3}{4}$"

C. 1"

D. $1\frac{1}{4}$"

E. $1\frac{1}{2}$"

F. $1\frac{3}{4}$"

G. $3\frac{1}{4}$"

H. 3"

I. $2\frac{3}{4}$"

J. $2\frac{1}{2}$"

K. $2\frac{1}{4}$"

L. 2"

1. J $\frac{1}{2} + \underline{2\frac{1}{2}} = 3$

2. D $1 + \underline{1\frac{1}{4}} = 2\frac{1}{4}$

3. C $3\frac{1}{4} - 2\frac{1}{4} = \underline{1}$

4. A $1\frac{3}{4} - 1\frac{1}{4} = \underline{\frac{1}{2}}$

5. F $2\frac{1}{2} - \frac{3}{4} = \underline{1\frac{3}{4}}$

6. H $2 + 1 = \underline{3}$

7. I $3\frac{1}{4} - \underline{2\frac{3}{4}} = \frac{1}{2}$

8. A $2\frac{1}{4} + \underline{\frac{1}{2}} = 2\frac{3}{4}$

9. A $2\frac{3}{4} + \underline{\frac{1}{2}} = 3\frac{1}{4}$

10. D $2 - \frac{3}{4} = \underline{1\frac{1}{4}}$

11. K $\frac{1}{2} + \frac{3}{4} + 1 = \underline{2\frac{1}{4}}$

12. E $\frac{1}{2} + 1 + \underline{1\frac{1}{2}} = 3$

13. G $1\frac{3}{4} + \frac{1}{2} + 1 = \underline{3\frac{1}{4}}$

14. A $1 + 1\frac{3}{4} + \underline{\frac{1}{2}} = 3\frac{1}{4}$

THE LONG AND SHORT OF IT - PUZZLE II

A. ______ G. ______

B. ______ H. ______

C. ______ I. ______

D. ______ J. ______

E. ______ K. ______

F. ______ L. ______

Directions:

1. Measure all lines to the nearest $\frac{1}{4}$ inch. Write the measure of each on the line segment.
2. Place measures in the spaces below the letters that are given.
3. Work the examples.
4. Place the correct letter in the original statement.

Samples:

B + C = <u>F</u>

$\frac{3}{4} + 1 = 1\frac{3}{4}$

G - <u>C</u> = K

$3\frac{1}{4} - 1 = 2\frac{1}{4}$

1. A + ___ = H

   ___ + ___ = ___

2. C + ___ = K

   ___ + ___ = ___

3. G - K = ___

   ___ - ___ = ___

4. F - D = ___

   ___ - ___ = ___

5. J - B = ___

_ - ____ = ____

6. L + C = ___

____ + ____ = ____

7. G - ___ = A

____ - ____ = ____

8. K + ____ = I

____ + ____ = ____

9. I + ___ = G

____ + ____ = ____

10. L - B = ___

____ - ____ = ____

11. A + B + C = ___

____ + ____ + ____ = ____

12. A + C + ___ = H

____ + ____ + ____ = ____

13. F + A + C = ___

____ + ____ + ____ = ____

14. C + F + ___ = G

____ + ____ + ____ = ____

HIDDEN WORD PUZZLE

Teacher Commentary

A Recreational Activity on Vocabulary Words From Fundamental Operations

I. Materials: Student work sheet with square array of letters

II. Procedure:

A. Give each student a dittoed sheet.

B. Have him find as many hidden math words as he can.

C. Solution:

	S	U	B	T	R	A	C	T	
						D			I
		S	U	M		D			N
					Z	E	R	O	V
Q	U	O	T	I	E	N	T		E
A		D	I	V	I	D	E		R
D	F	R	A	C	T	I	O	N	S
D	I	F	F	E	R	E	N	C	E
			P	R	O	D	U	C	T
	M	U	L	T	I	P	L	Y	

FUNDAMENTAL OPERATIONS PUZZLE

See what math words you can find in the puzzle below. Some words run across. Some words run down. Altogether there are 12 words. How many can you find?

E	S	U	B	T	R	A	C	T	T
A	B	R	E	O	L	D	U	M	I
N	Y	S	U	M	A	D	V	S	N
C	I	D	W	L	Z	E	R	O	V
Q	U	O	T	I	E	N	T	I	E
A	G	D	I	V	I	D	E	X	R
D	F	R	A	C	T	I	O	N	S
D	I	F	F	E	R	E	N	C	E
O	H	A	P	R	O	D	U	C	T
R	M	U	L	T	I	P	L	Y	X

HIDDEN MESSAGE

Teacher Commentary

A Recreational Activity on Division of Whole Numbers

I. Materials: Student work sheets

II. Procedure:

A. Distribute a work sheet to each student

B. Students are to decode the hidden message

C. Solution:

You Know Your Facts

A HIDDEN MESSAGE

Secret messages are sometimes in code. Often the code will have numbers or letters in it. Today you will figure out a message by solving some examples.

I. The solution to each problem stands for a letter.

1. $75 \div 3$ __________
2. $\frac{1}{3}$ of 45 __________
3. $4\overline{)84}$ __________
4. $121 \div 11$ __________
5. $98 \div 7$ __________
6. $\frac{1}{5}$ of 75 __________
7. 115 divided by 5 __________
8. $\frac{125}{5}$ __________
9. $45 \div 3$ __________
10. $105 \div 5$ __________
11. $126 \div 7$ __________
12. $\frac{12}{2}$ __________
13. Any number divided by itself. __________
14. $\frac{9}{3}$ __________
15. $7\overline{)140}$ __________
16. $152 \div 8$ __________

II. Below is the decoder. Right under each number you have for an answer is a letter. Put this letter in the corresponding numbered spaces. Then you will see the message.

DECODER

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

HIDDEN MESSAGE

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

___ ___ ___ ___ ___
12 13 14 15 16

WORD MAZE

Teacher Commentary

A Recreational Activity on Vocabulary Words From Measurement

I. Materials: Work sheet with square array of letters

II. Procedure:

A. Give each student a work sheet

B. Have each student try to find the 11 math words hidden in each maze

C. You may or may not give the list of words to be found to the students along with the work sheets

Hidden Words:

1. count
2. inch
3. nine
4. ninety
5. one
6. ounce
7. pint
8. pound
9. ten
10. twenty
11. yard

WORD MAZE

Eleven math words are hidden in the large square below. Can you find them? Here's what to do:

You may start in any of the smaller squares and move in any direction to any square next to it. You may continue to move one square in any direction until a word is made. You may not enter the same smaller square twice while spelling a word.

Y	T	W	H
A	T	E	C
R	I	N	O
N	D	P	U

SCRAMBLED WORDS

Teacher Commentary

A Recreational Activity on Vocabulary Words for Fractions

I. Materials: Work sheets with words scrambled

II. Procedure:

A. Give each student a work sheet.

B. Have each student unscramble the words.

C. Solution:

1. division
2. denominator
3. subtraction
4. number
5. fraction

SCRAMBLED WORDS

Unscramble the letters to form math words:

1. sidviion
2. rotanimoned
3. bustarctoin
4. uernbm
5. ricofant

SCRAMBLED WORDS

Teacher Commentary

A Recreational Activity on Vocabulary Words for Whole Numbers

I. Materials: Work sheets of scrambled words

II. Procedure:

A. Hand out work sheets to students.

B. Have students unscramble words.

C. Solution:

1. billion
2. estimate
3. prime
4. composite
5. power

SCRAMBLED WORDS

Unscramble the letters to form math words:

1. lionbil
2. timaeest
3. rimpe
4. tipomocse
5. woper

SCRAMBLED WORDS

Teacher Commentary

A Recreational Activity on Vocabulary for Geometry

I. Materials: Work sheet of scrambled words

II. Procedure:

A. Give each student a work sheet.

B. Have each student unscramble the letters to form vocabulary words.

C. Solution:

1. angle
2. cube
3. square
4. parallelogram
5. rectangle
6. triangle

SCRAMBLED WORDS

Put the letters in the right order to find math words:

1. agnel
2. buce
3. qaseru
4. aparlellgoamr
5. reecatngl
6. ratigeln

WHAT'S THE MYSTERY WORD?

Teacher Commentary

A Recreational Activity on Geometric Vocabulary

I. Materials:

A. Work sheets

B. Pencils

II. Procedure:

A. Distribute work sheets entitled, "What's the Mystery Word?"

B. Have directions read silently

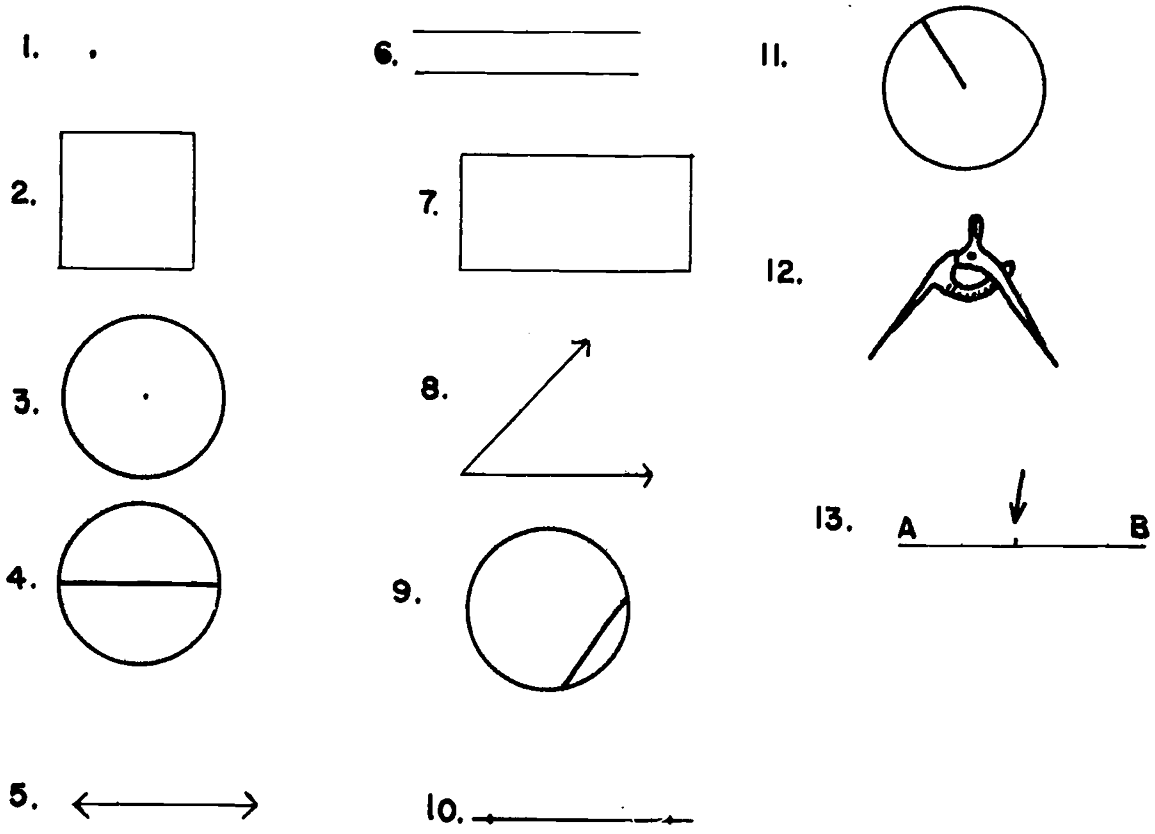
C. Explain that words to be used to complete the puzzle are listed at the bottom of the sheet. There are more words listed than are needed.

D. Solution:

```
      Point
    squAre
     ciRcle
     diAmeter
      Line
paralleL lines
       rEctangle
    angLe
     chOrd
     seGment
      Radius
   compAss
      Midpoint
```

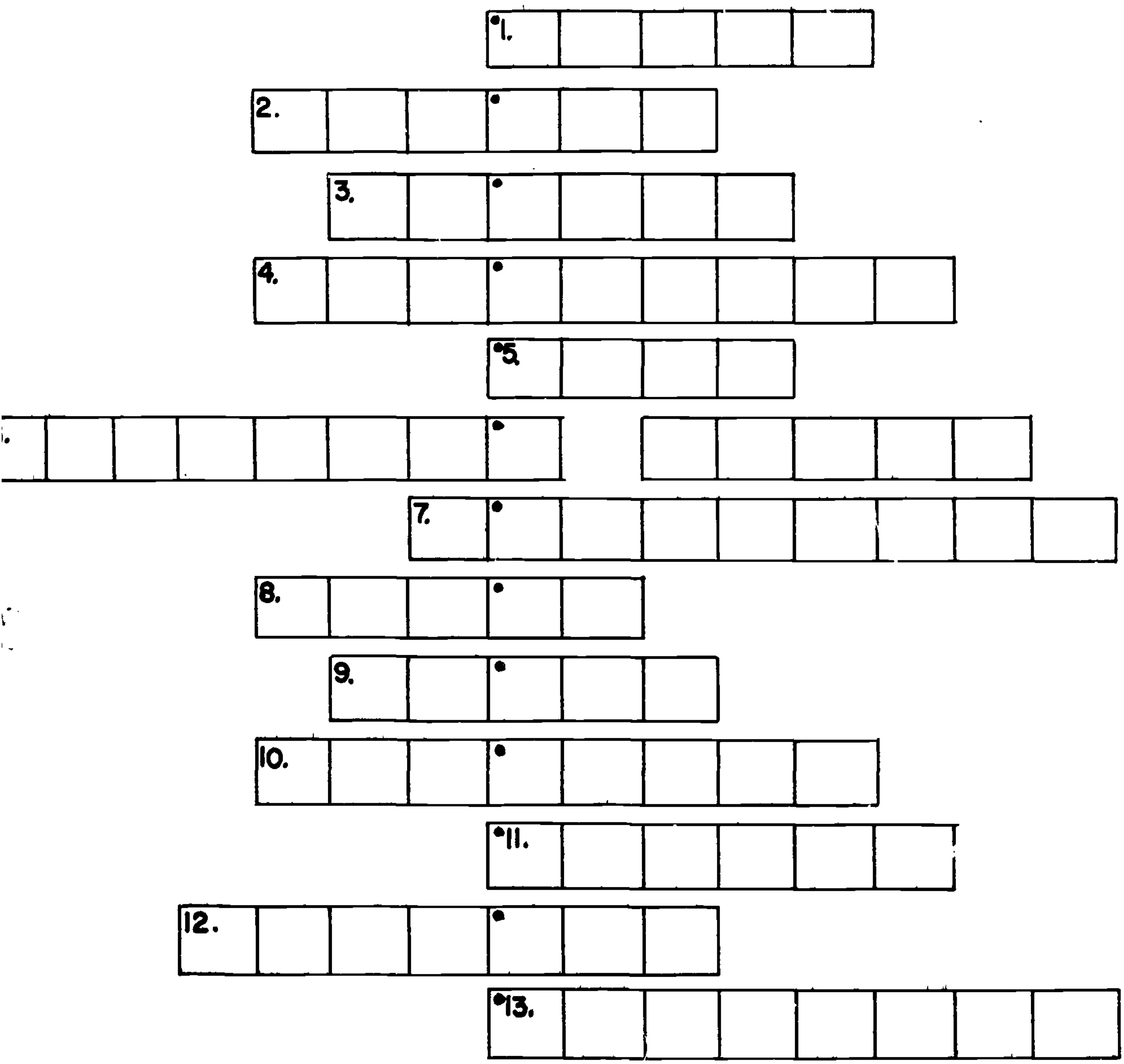
WHAT'S THE MYSTERY WORD?

Directions: Complete the puzzle with the name that identifies each thing below. If your answers are all correct, each block with a dot in it, reading downward, will spell the mystery word.



Words to be used may be selected from the following list:

triangle	radius	square	line	parallel lines
diameter	rectangle	chord	point	median
angle	midpoint	segment	plane	vertex
circle	trapezoid	ray	compass	path


1.
2.
3.
4.
5.
7.
8.
9.
10.
11.
12.
13.