DOCUMENT RESUME

ED 050 070 SP 007 149

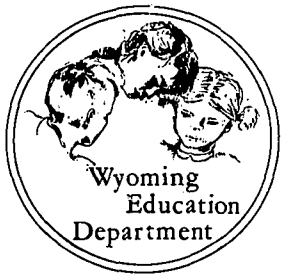
TITLE	Wyoming Mathematics Curriculum Guide, Grades K-6.
INSTITUTION	Wyoming State Dept. of Education, Cheyenne.
PUB DATE	69
NOTE	80p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS	Behavioral Objectives, *Curriculum Guides, *Elementary School Mathematics, Grade 1, Grade 2, Grade 3, Grade 4, Grade 5, Grade 6, Kindergarten, *Mathematical Concepts, *Mathematics Curriculum, *Mathematics Materials

ABSTRACT

GRADES OR AGES: K-6. SUBJECT MATTER: Mathematics. ORGANIZATION AND PHYSICAL APPEARANCE: There are three chapters: 1) Scope and Sequence--the spiral approach to learning, using the scope and sequence, scope and sequence charts, and glossary for teachers; 2) objectives in Mathematics--behavioral objectives for elementary mathematics and evaluation in elementary mathematics; 3) Resources for Teachers. The scope and sequence charts are on gatefolds. The guide is printed and spiral bound with a soft cover. OBJECTIVES AND ACTIVITIES: The general objectives are set out, followed by sample behavioral objectives for each grade. The scope and sequence charts suggest activities for each grade but do not attempt to provide a detailed lesson plan. INSTRUCTIONAL MATERIALS: Chapter 3 contains extensive information on materials, under the headings: concrete materials for use with children, books for primary children, books for intermediate children, films, filmstrips, manipulative devices, programed instruction materials, teacher's resource materials, teaching tapes, and transparencies. STUDENT ASSESSMENT: Chapter 2 includes a section on three types of evaluation and lists the questions to be considered in the process. (MBM)

Wyoming Mathematics Curricul

Grades K-6



1969

Prepared by

THE ELEMENTARY MATHEMATICS CURRICULUM COMMITTEE OF WYOMING under a grant with the U.S. Office of Education, as authorized under Title V, Elementary and Secondary Education Act, 1965.

ıg Mathematics Curriculum Guide

Grades K-6

1969

Published by
THE STATE DEPARTMENT OF EDUCATION
Cheyenne, Wyoming 82001

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FOREWORD

Mathematics education has been undergoing rapid changes during the last few decades. Technological advances in our society require a better background in mathematics. The mathematics program should provide each individual student, according to his ability, with an understanding of mathematics adequate for his current and future needs.

The program of mathematics in our schools should be modernized in such a way that our children can understand the basic principles involved and become acquainted with new concepts. Instruction should involve periods of exploration, experimentation and inquiry. Through the program the student should become aware of the power and influences of mathematics in his continuing vocational and personal development.

The State Department of Education gratefully acknowledges the contribution of the members of the Elementary Mathematics Curriculum Committee of Wyoming who prepared this guide.

It is my hope that curriculum development in Wyoming will be an on-going process. Through this process, further developments and revisions can be looked for in the future.

I believe that you, the teachers of the state, will find this guide a useful resource and hope that you feel free to react to it so that your suggestions can be incorporated into future developments.

HARRY ROBERTS
State Superintendent of Public Instruction

June, 1969

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It is important to understand the purpose of modern mathematics, viewing it as a whole, rather than just gaining knowledge of a few of the topics. In teaching mathematics today, we hope to produce pupils who understand the "why" of numbers and operations in addition to the "how" of computational skills. Furthermore, pupils are presented with the basic principles that underlie mathematics, whether mathematics is being studied at a primary or a high school level. Knowledge of the principles and their applications not only reduces the number of rules to be memorized but helps the pupil become cognizant of the fact that there is a structure and organization to mathematics. Through using discovery techniques, pupils become actively involved in finding patterns, generalizations, and rules for themselves, thus retaining what they learned more easily and developing more effective reasoning ability as well.[1]

Most of what has been written and of what we try to teach can be summarized under four major headings. Modern mathematics is an attempt to: (1) emphasize the "why" just as much as the "how," (2) teach mathematics as a structure, (3) allow pupils to discover relationships for themselves whenever possible, (4) teach the social utility, or practical applications of mathematics and of arithmetic computation. It is important for teachers or parents upon being introduced to a new concept to take time to see how it contributes to these major purposes. There are many false impressions about "modern" mathematics. An attempt is made in the following discussion to correct some of these erroneous ideas.

INTRODUCTION

WHAT MODERN MATHEMATICS IS AND IS NOT

Modern mathematics is just a downward shifting of topics . . . . . *False*

While there has been a downward shifting of the grade placement of certain topics, this is not a basic purpose of modern mathematics. Where this downward shift has occurred, the emphasis has not been so much on mastering a skill earlier as it has been on carefully developing a concept or intuitively dealing with a mathematical idea that will be treated more formally in future years. In most cases enrichment materials have been included along with extensive amounts of supplementary or additional materials. The additional materials have, in a large part, been included to teach the structure of mathematics.

Modern mathematics is an attempt to teach the "why" of mathematics . . . . . *True*

Adults today have little idea why they do certain things in arithmetic. Upon hearing an explanation of "regrouping" or "borrowing" in subtraction, it is not unusual for adults to state that they now understand for the first time what they are doing. Arithmetic begins to make sense to them.

[1]Paul R. Trafton, *Insight into Modern Mathematics* (The New Math) Ideal School Supply Co. (1963) pp. 4-10.

Modern mathematics means throwing out many previously taught topics ..... *False*

Undoubtedly there are many teachers who wish that this statement were true, particularly with more difficult multiplication and division ideas. However, a close inspection of curriculum materials will indicate that few topics are being discarded. It is true that many concepts are being presented from a different viewpoint and that certain applications are not receiving as much emphasis as formerly.

Modern mathematics is an attempt to teach mathematics as a structure ..... *True*

In mathematics, there are a few key principles, usually considered to number less than twelve, around which most of the development of arithmetic can be built.

Modern mathematics means doing away with drill ..... *False*

This is not true. Drill still plays an important role in mathematics, and children are still expected to learn basic facts. Yet it is true that drill for the sake of drill is being de-emphasized. Attempts are also being made to make drill more creative by using it in situations that call for reasoning at the same time.

Attempts are made to lead pupils to discover mathematical relationships for themselves. A balance between drill for reinforcement and intuitional understanding is necessary if a mathematics program is to be of utilitarian value.

Modern mathematics seeks to use "discovery" techniques ..... *True*

The idea of "discovery" can be referred to as the method of modern mathematics. The topics taught are important, yet if they are taught in a rote, mechanical manner, with an emphasis on symbol manipulation instead of insight, little advantage is gained. However, when the concepts involved in the new emphasis are presented in an interesting manner, and pupils are given an opportunity to explore, raise questions, and generalize, there is much to be gained.

Modern mathematics is just for the "bright" kids . . . . . *False*

If modern mathematics is to be of value, it must be able to help all levels of learners. It is true that the new emphasis does allow pupils with mathematical insight a chance to use more of their talent, and it keeps them from becoming bored. However, while the need to challenge able pupils is being met more adequately, the mathematical needs of average and below average pupils are also being met more satisfactorily than has usually been done in traditional programs. The new emphasis can be of great value to them. It is these pupils who became "bogged down" in rules and manipulations in the past and who can profit from the emphasis on key concepts and greater insight.

It should be recognized that there will be a few pupils who will continue to have difficulty with mathematics. Special programs in terms of a slower pace and limited context should be used to best provide for these people's needs.

Modern mathematics is just sets, bases, revised terminology, geometry and number lines . . . . . *False*

To view modern mathematics only as a series of topics is to miss what it is really trying to accomplish. While these topics are important, their inclusion is for more than just knowledge of them. They are included because they contribute to a much larger picture.

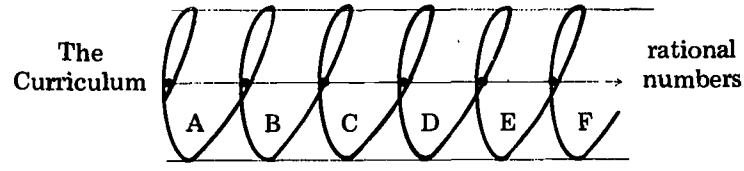
Modern mathematics means we have been doing a bad job . . . . . *False*

There are many teachers who have worked hard at teaching arithmetic for many years who unfortunately see the new approaches as an indication that they have been doing a poor job. Many of these people have been doing a fine job. In fact, it is not unusual to hear teachers in a modern math course exclaim, "Why, I've been teaching modern math and didn't even know it!"

THE SPIRAL APPROACH TO LEARNING

The spiral approach to learning is often emphasized in teaching modern mathematics. This method or approach develops a concept from the intuitive level to the analytic level by spacing instruction. The method will also develop a concept from exploration to mastery.

The following diagram will help illustrate the spiral approach to learning:



In the elementary school, pupils study the rational numbers by participating or by considering parts of regions and subsets (A). The rational numbers are studied on the number line (B). Soon the rational numbers are studied by using equivalent subsets (C). Later the rational numbers are ordered (D). Then the operation of addition is performed upon the set of rational numbers (E). The operation of multiplication is then performed upon the set of rational numbers (F).

This approach involves the teaching of rational numbers and its related concepts at several points in the curriculum separated by a period of time. With each new exposure to the

CHAPTER I – SCOPE AND SEQUENCE

rational numbers a new approach is taken and a higher level of sophistication is gained.

The student studies the rational numbers in terms of regions and subsets. This is followed by studying the rational numbers on the number line. Later the rational numbers are studied by using equivalent subsets. Complete mastery is not necessary on any one level as the rational numbers will be reviewed and extended on each level.

USING THE SCOPE AND SEQUENCE

The importance, impact, and emphasis of the modern approaches to mathematics in education have been strongly felt in the public schools since the 1950's. The extent, variation, use and application of these approaches are expanding and becoming more effective as we learn more about teaching techniques and the individual child. The Elementary Mathematics Curriculum Committee has developed the following scope and sequence chart in the hope that it will be a helpful guide for those people working with the elementary mathematics programs in the Wyoming schools.

The concepts are listed at the grade levels where they are formally introduced. Most concepts are preceded by readiness activities. Following the introduction of a concept, complete mastery may take three years or longer, depending on individual differences and the degree of reteaching and extension. It is important that the elementary ideas will

enhance the further teaching of the mathematical concepts within each modern mathematics program.

In view of the fact that most Wyoming schools are structured by grade level, the scope and sequence chart has been arranged accordingly. The committee, however, does not discourage the implementation of trends in elementary education such as non-graded or continuous progress schools. These experimental programs should be able to adopt and adapt the scope and sequence chart to meet their varied structures, goals, and policies.

The committee is of the opinion that where financially and physically possible, school districts should develop a kindergarten program. When the adoption of such a program is not feasible at the present time, the teachers of the subsequent grades or levels should adjust their programs to incorporate those concepts which would have been covered in a kindergarten program.

This scope and sequence chart is the result of the accumulation of ideas from the committee members, textbook series, and other local and state curriculum projects. The committee does not wish to imply that every single concept listed here be covered at these exact grade levels, that this list contains the only concepts that should be or are being taught, or that in certain situations, every concept in this scope and sequence should be taught. The chart is intended to be a guide and not a requirement for elementary teachers and individuals interested in the development of elementary curriculums.

	K	1	
Concept of sets	Comparing familiar objects (larger-smaller). Cardinal numbers. Simple union.	One-to-one correspondence. Equivalent sets. Non equivalent sets. Union and set separation. Set notation (reading and recognition). Elements of sets. Empty sets. Subset.	Writing set not Union of sets a disjoint sets Regrouping set Equivalent sets
Properties and techniques of operations on numbers	Union of sets as model for addition and subtraction. Simple number addition of sums up to 9. (Oral only) Commutative law of addition (intuitive idea of).	Adding whole numbers (number line, sets, etc.) Use of zero as the additive identity. Two digit addition and subtraction combinations through 20 (no renaming). [Renaming frequently referred to as carrying, borrowing, etc.] Expanded notation. Vertical notation. Subtraction using zero and a number from itself. Commutative property of addition. Inverse operations (families of facts.)	One, two, and Missing addend Missing sums. Missing operati Basic multiplic Parts of whole Subtraction as addition. Multiplication Renaming.
Mathematical sentences	Visualization of larger, smaller, greater than, equal to. Using patterns to show one more, one less, same.	Comparison of two numbers. Relation symbols, >, <= and ≠ Recognition of signs of operation (+, −) Simple number sentences. Simple word problems. Simple place holder is introduced to make simple sentences.	Sentence inequ Missing inequa Solving senten tion and rel One step story tences.

SCOPE AND SEQUENCE CHART

2	3	4	
Writing set notation using braces. Union of sets as addition using disjoint sets. Regrouping sets. Equivalent sets.	Union of sets. Intersection of sets. Solution sets. Finite sets. Infinite sets. Set notation (roster and description). Number pairs (formal introduction). 4 sets of 3. 3 sets of 4.	Equal sets. Extension of ideas using subsets. Union as addition. Intersection of sets of points and lines. Venn diagrams. Diagrams to show union. Intersections of sets of numbers. Sets in logical thinking.	Sets of numbers Disjoint sets. Ordered pairs. Lines continued plications to sized.
One, two, and three digit numbers. Missing addends. Missing sums. Missing operation signs. Basic multiplication facts. Parts of wholes. Subtraction as inverse operation of addition. Multiplication on the number line. Renaming.	Inverse of multiplication. Repeated subtraction up to and including 7-digit numbers. Natural numbers, whole numbers, fractions, integers. Zero property of addition. Zero property of multiplication of simple products. Property of one in addition, subtraction, multiplication, and division. Commutative law, associative law, distributive law as applied to addition and subtraction.	Binary operations defined. Properties of operation emphasized (formal naming, i. e. identity). Inverse relationship of (1) addition and subtraction (2) multiplication and division. Addition and subtraction of fractions with like denominators. Common denominator. Commutative, associative, and distributive laws applied to multiplication and division.	Products and fa Greatest comm Least common prime numbe Addition and su tions without ator. Multiplication Inverse operatic fractions. Addition and su mal fractions Multiplication duced. Zero property Addition with
Sentence inequalities. Missing inequality signs. Solving sentences involving operation and relation symbols. One step story problems and sentences.	Inequalities included in multiplication and division. Facts of addition, multiplication, division and subtraction. Sentences derived from story problems.	Story problems involving fractions. Substituting missing numbers. Missing sets for inequalities. Equations from story problems. (2 step problems.) Sentences which are true, false or neither true nor false.	Sentences invol fractions, an Sentences with tions). Associativity a Sentences deriv lems. Graphing math

4	5	6
Equal sets. Extension of ideas using subsets. Union as addition. Intersection of sets of points and lines. Venn diagrams. Diagrams to show union. Intersections of sets of numbers. Sets in logical thinking.	Sets of numbers. Disjoint sets. Ordered pairs. Lines continued and extended, applications to geometry emphasized.	Review of subsets. Infinite sets. Finite sets. Solution sets. Replacement sets.
Binary operations defined. Properties of operation emphasized (formal naming, i. e. identity). Inverse relationship of (1) addition and subtraction (2) multiplication and division. Addition and subtraction of fractions with like denominators. Common denominator. Commutative, associative, and distributive laws applied to multiplication and division.	Products and factors. Greatest common factor. Least common multiple (use of prime numbers). Addition and subtraction of fractions without common denominator. Multiplication of fractions. Inverse operation for division of fractions. Addition and subtraction of decimal fractions. Multiplication of decimals introduced. Zero property of division. Addition with signed numbers.	Extensive review of grade 5 ideas. Inverse operations to solve problems. Addition, subtraction, multiplication and division of decimals. Intuitive introduction of square root. Division with fractional numbers. Subtraction with signed numbers.
tory problems involving fractions. ubstituting missing numbers. lissing sets for inequalities. quations from story problems. (2 step problems.) entences which are true, false or neither true nor false.	Sentences involving exponents, fractions, and decimals. Sentences with 2 variables (functions). Associativity and commutativity. Sentences derived from story problems. Graphing mathematical sentences.	Sentences dealing with inequalities and equalities. Story problems related to inequalities. Sentences with 2 or more variables (functions). Sentences which are true or false (closed). Sentences which are neither true nor false (open).

SCOPE AND SEQUENCE

Concept of Sets

Properties and Techniques of Operations on Numbers

Mathematical Sentences

	K	1	
Numbers, Numerals and Simple Number Theory	Counting by ones. Meaning of more, most, less, fewer. Meaning of first, second, . . ., last. Numerals 1-10 (recognition). Odd and even (introduction). Counting by two's (skip counting). Ordering numbers (number line). Counting numbers. Recognition of groups without counting (cardinal number). Fractions (parts are the same size).	Recognizing groups without counting. Counting by ones, two's, threes, fives and tens. Number line. Word and mathematical names for numbers (word and numeral). Naming sets of cardinal numbers. Odd and even numbers (divisible by 2 not divisible by 2). Simple fractions (½, ¼).	Counting b Reading an (0-1000) Equivalent ber. Odd and ev Relation of counting Fractions (Fractions o Equations. Estimations
Systems of Numeration	Counting. One to one correspondence. Equivalent sets (same number property by matching with lines).	Using the ten digits (0-9). Place value (0-100). Preliminary work on expanded notation. (e. g. 12 10 + 2 etc.)	Place value Expanded r
Geometry	Shapes in pegboards (square, rectangle, triangle, etc.). Idea of a plane (intuitive). Recognition of shapes. Intuitive geometry. Rubber band geometry.	Points inside, outside, and on curves (area and perimeter) Recognition of shapes. Definition of simple closed curves. Idea of a point. Set of points.	Negative nu in a squa Illustrating Line segme Number lin (1) order (2) mode

	2	3	4
s without count- two's, threes, atical names for and numeral). dinal numbers. bers (divisible by y 2). ½, ¼).	Counting by 3's, 4's, 6's . . ., 10's. Reading and writing numerals (0-1000). Equivalent names for the same number. Odd and even (patterns for 5). Relation of ordinal numbers to counting numbers. Fractions (2/3, 3/4, 1/6). Fractions on a number line. Equations. Estimations (introduction).	Odd and even (divisible by 5 or not divisible by 5). Multiples. Factors. Fraction-equivalent names for. Simple mixed numerals. Simple decimals. Rounding numbers on a number line. Estimating numbers. Rates. Prime numbers.	Common multiples. Common factors. Divisibility by 3 and 9. Prime numbers. Composite numbers. Sets and the number line. Equivalent fractions. Like fractions. Equivalent names for mixed numbers. Estimating numbers. Rates.
s (0-9).). bn expanded 12 10 + 2 etc.)	Place value numerals (0-1000). Expanded notation to thousands.	Place value numerals through the millions. Expanded notation through millions. Early numeration systems.	Place value in other bases. Systems of numerations in bases other than base 10. Expanded notation in other bases. Modular or clock arithmetic.
ide, and on curves eter) apes. le closed curves.	Negative number line. Regions as in a square, rectangle, etc. Illustrating regions and segments. Line segments. Number lines: (1) order relation (2) model for addition.	Ideas of separation e. g. a point separates a line into two parts. Quadrilateral, parallelograms, rays, right angles, planes. Properties of the above shapes. Congruence (introduction). Rays. Angles. Negative numbers and fractions on the number line.	Regions inside of polygons. Properties of polygons. Intersection of two lines or two planes. Parallel lines and planes. Intersection of three planes. Lines of symmetry. Paths, plane, curves, polygons, pyramids, cylinders, cones, spheres and cubes. Line and plane separation.

4	5	6
multiples. factors. y by 3 and 9. nbers. numbers. he number line. fractions. ons. names for mixed num- numbers.	Divisibility by 4, 6, and 8. Least common multiple. Greatest common multiple. Prime numbers. Composite numbers. Prime facterization. Equivalent fractions. Decimal fractions. Ratio. Percent (equivalent names for fractions).	Equivalent names for numbers. Rational numbers. Proportions. Percent Percent of a number. Integers. Numerals for integers. Integers on a number line. Sequences.
in other bases. numerations in bases an base 10. notation in other clock arithmetic.	Place value in other bases. Continued work with other base systems (5,6,8 etc.) Expanded notation. [Computation in other bases may be used as an extension for the better students, but mastery is neither necessary nor desirable.]	Place value other bases. Base two notation.
ide of polygons. of polygons. of two lines or two s and planes. of three planes. nmetry. , curves, polygons, , cylinders, cones, nd cubes. ane separation.	Pythagorean theorem. Congruent and similar figures. Formulas for area and perimeter. Review of forms studied in grade 4. Other polygons and solids. Parallel lines cut by a transversal.	Quadrant separation of a plane. Coordinates as ordered pairs. Isoceles triangles. Equilateral triangles. Simple geometric constructions. Scale drawing. Reading and interpreting from scale drawings. Definition of geometric figures in set language. Separation of sets of points by closed figures. Interior and exterior sets of points. Extensions of congruent and similar figures.

SCOPE AND SEQUENCE (Continued)

Numbers, Numerals and Simple Number Theory

Systems of Numeration

Geometry

	K	1	
Measurement	Concepts of temperature, warmer or cooler. Comparisons of length, size and weight. Verbal and sight coin recognition of money. Intuitive ideas of units of measure.	The equivalent value and written name recognition of coins to a quarter. Time relationships of one hour and one-half hour. Units of measure. Linear measure. Temperature. Days of the week. Months of the year.	Equivalent val volving $.5(Simple change Time relation hour. Calendar relat
Probability and Statistics	Picture graphs.	Picture graphs and simple bar graphs to compare two objects. Development of simple tables.	Graphs on nu Tallying data.

	2	3	4	
en) a and	Equivalent values of money involving $.50 to $1.00. Simple change making. Time relationships of one quarter hour. Calendar relationships.	The use of the dollar sign and decimal point in money. Making change. Time intervals of five minutes. Simple areas. Equivalent measures.	Dry measure. Area and perimeter. Measurements of simple geometric figures. Unit relationships of liquid measure. Metric units used in linear, weight and volume measures.	Areas as squ Areas of squ Angle meas Volume: cu Lateral and Simple form dent disc
:ts.	Graphs on number lines. Tallying data.	One dimensional line graphs including fractions. Circle, bar and coordinate graphs.	Line graphs. Co-ordinates. Range. Average.	Scale readin Ratios in tw More line gr Median. Event. Mutually ex Zero probab One probab

4	5	6
ıeter. of simple geometric ips of liquid measure. ed in linear, weight measures.	Areas as square units. Areas of squares and rectangles. Angle measurements. Volume: cubic measure. Lateral and total surface areas. Simple formula development (student discovery emphasized).	Volume: cubic measure of geometric space figures. Relationships of dry and liquid measure. Circumference of a circle. Rounding numbers (accuracy).
	Scale reading. Ratios in two dimensional scales. More line graphs. Median. Event. Mutually exclusive events. Zero probability. One probability.	Organizing data. Rate and statistical graphs. Plotting points from ordered pairs. Extension of range, average and median. Fractional probability.

SCOPE AND SEQUENCE (Continued)

Measurement

Probability and Statistics

GLOSSARY FOR TEACHERS

This glossary is intended as an aid for the teacher of elementary mathematics. The teacher can use the glossary to determine the meaning, and in some cases descriptions or applications, of the widely used terms found in the Scope and Sequence section of the guide.

In some cases the definitions or descriptions in this section are given to provide greater usability in the elementary classroom at the expense of mathematical rigor.

The committee does not intend for this glossary to be used as a teaching device, but rather hopes that it will serve as a tool to help the teacher in his or her classroom work.

Addend:

A number or quantity to be added to another or augmented.

Addition:

An operation that combines a first number and a second number to give exactly one number.

Algorithm or Algorism:

A form for performing the computations associated with an operation in arithmetic.

Angle:

Two rays with a common end point.

Arc:

A portion of a circle determined by any two points on the circle.

Arc degree:

A standard unit of measure that is 1/360 of a circle.

Area:

The measure of the space enclosed by a closed figure; the measure of a region.

Array:

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columns.

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Central angle:

An angle th

Circle:

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Circumference:

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Closed curve:

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point and r

Array:

A set arranged in rows and columns so that each row has as many objects in it as each of the other rows, and each column has as many objects in it as each of the other columns.

Associative principle:

If the manner in which 3 or more numbers are to be grouped to perform an operation does not affect the result, the operation is said to be associative.

Average:

The sum of all the numbers in the set divided by the number of elements in the set (the number of the set).

Base:

The number used for grouping in a numeration system.

Binary numeration system:

A base system consisting of two symbols. A system of notation with base two.

Brace:

Mathematical characters or symbols which enclose a set { }

Central angle:

An angle that has the center of a circle as its vertex.

Circle:

A plane closed curve that is the set of all points at a fixed distance from a point called the center that is also in the plane.

Circumference:

The measure of the distance around a circle.

Closed curve:

A plane figure that can be drawn by starting at one point and returning to that point.

Closure:

A set is said to have the property of closure for any given operation if the result of performing the operation on any two members of the set is a number which is also a member of the set.

Common denominator:

A denominator (part of the fractional number indicating the number of equal parts) which is divisible by all of the denominators involved.

Common factor:

When a number is a factor of two different numbers, it is said to be a common factor of the two numbers.

Commutative principle:

A basic mathematical concept that the order in which *certain* operations are performed does not affect the result.

Complex fraction:

A fraction in which either or each of the terms is named by a proper, improper, or mixed decimal fraction.

Composite number:

A counting number which is divisible by a smaller counting number different from 1.

Congruent figures:

Figures that have the same size and shape.

Cone:

A space figure consisting of the union of all line segments connecting a circular plane region with a point not in the plane, called the vertex. May be solid as well as a surface.

Coordinates:

Any of a number of magnitudes that determine position.

Counting numbers:

Numbers used to identify objects in a series.

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Cube:

A regular solid of six equal square sides.

Cubic measure:

Third dimensional measure denoting the volume of a solid figure.

Curve:

In geometry, a path that can be drawn without lifting the pencil from the paper.

Cylinder:

A surface with bases which are congruent circles lying in parallel planes and with a lateral surface made up of the parallel segments whose end points are in the circles.

Decimal numbers:

Numerals such as .3 and .62 are referred to as decimal fractions while 3.5, 4.26 etc., are called mixed decimal fractions. For convenience both are called decimals.

Decimal numeral systems:

A system of expressing numbers that uses ten digits and gives each place in a given numeral ten times the value of the place at its right.

Degree:

A standard of angular measurement.

Denominator:

The bottom part of a fraction or that part which indicates the number of parts which are equally divided.

Diameter:

A line segment containing the center of a circle and whose end points are on that circle.

Digit:

Any of the ten symbols used in our numeration system; 0,1,2,3,4,5,6,7,8,9. (From the Latin, "digitus," or "finger".)

Disjoint sets:

Sets that have no members in common.

Distributive principle:

A concept that relates two operations. Multiplication is distributive over addition—

Ex: a x (b + c) = (a x b) + (a x c)

Division:

The process of determining the number of times that one quantity is contained in another.

Dry measure:

A system of measuring volume of dry articles (grain, etc.).

Edge:

The intersection of two polygonal regions which are the faces of the surface of a solid.

Elements of sets:

All of the parts or members which make up a set.

Empty set:

A set which contains no members.

Equation:

A statement of equality whereby a mathematical sentence has two expressions joined by an equal sign.

Equivalent fractions:

Fractions that name the same fractional number.

Equivalent sets:

Sets that have the same number of members.

Error of measurement:

The difference between the stated measure and the true measure.

Even number:

A whole number that has 2 as a factor. 0,2,4,6 are even numbers.

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Expanded notation:

A method of writing a numeral showing its place value in terms of a particular base system.

Ex: $342^{5} = (3 \times 5^{2}) + (4 \times 5^{1}) + (2 \times 5^{0})$

Exponent:

A numeral that indicates how many times a number is used as a factor in finding a product.

Face:

A plane figure and its interior side, which is taken from a solid figure, is a face.

Factor of a given number:

Any one of two or more numbers whose product is the given number.

Finite set:

A finite set is one that is limited in size.

Fraction:

A numeral such as 3/4, 12/7. Fractions are names for numbers.

Fractional number:

Any number that can be named as a fraction.

Geometry:

A system of mathematics which deals with the properties of figures and with relationships between the elements of figures.

Great circle:

A circle formed by the intersection of a sphere and a plane passed through its center.

Identity element:

For any given operation on the member of a set a certain number is the identity element for the operation if the following is true: Whenever we perform the

operation on this number and any number N, we obtain N as the result.

E.g.: 3 + 0 = 3, 6 + 0 = 6

Zero is the additive identity

3 x 1 = 3, 6 x 1 = 6

One is the multiplicative identity

Inequality:

In arithmetic a relation indicating that the two numbers are not the same, or that one is greater (or less) than the other.

Integer:

Any one of the set of numbers which consists of the natural numbers, their opposites and zero.

Intersection:

A set that contains the members common to two or more other sets.

Inverse:

A term meaning opposite. Subtraction is the inverse of addition.

Irrational number:

A number that cannot be represented as a terminating decimal, a repeating decimal or the quotient of a pair of integers.

Lateral area:

The sum of the areas of the lateral faces of a solid figure.

Lateral surface:

The surface of a prism, pyramid, cone or cylinder excluding the base.

Least common multiple:

The smallest number that a given set of numbers will divide into evenly, i.e., 12 is the L. C. M. of 3 and 4; 18 is the L. C. M. of 3, 6, and 9.

Line:
A set of points that correspond to our idea of a "straight line."

Line segment:
The set of all points on a line between and including two specific points called end points.

Medium event:
Average point.

Metric units:
Units of measure in the metric system.

Modular:
Repeating as on a clock face.

Natural numbers:
Those positive whole numbers appearing in nature.

Negative numbers:
Any number less than zero on the number line.

Notation:
The use of signs, symbols and numerals in mathematics.

Multiples:
Those numerals obtained by multiplying by 1,2,3, ...

Number:
A basic concept which is associated with a set. Ordinal: a number which denotes order to tells the story of which one. Cardinal: a number designating the "how many" of a set of things.

Numeral:
A symbol used to represent or name a number.

Ordered pair:
A pair of objects in a set of two where one of them is specified as being first.

Parallel:

Two lines in the same plane which are always the same distance apart.

Percent:

Per one hundred or for each one hundred.

Perimeter:

The sum of the distances around all sides of a polygon.

Place value:

The value of a digit dependent upon its position in a numeral.

Plane:

A flat surface extending indefinitely in all directions.

Polygon:

A closed figure in a plane with straight line segments joined end to end.

Positive number:

Any number greater than zero on the number line.

Prime factorization:

Only the prime numbers used as factors such as $12 = 3 \times 2 \times 2$.

Prime number:

A counting number other than one, which is divisible only by itself and one.

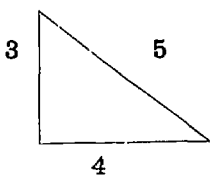
Pyramid:

A closed space figure whose base is bounded by a polygon and whose faces are bounded by triangles having a common vertex.

Pythagorean theorem:

The square of the hypotenuse of a right triangle is equal to the sum of the squares of the other two sides.

Ex:



$5^2 = 4^2 + 3^2$

Quadrilateral:

A polygon with four sides.

Range:

A series within limits.

Rates:

Quotient of 2 numbers which are named differently such as 20 miles/60 minutes; 20 miles per hour; 1/3; or 1 mile each 3 minutes.

Ratio:

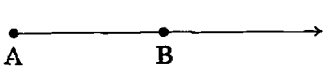
Quotient of 2 numbers

Rationals:

Numbers which when written in form a/b are not equal to zero and a is a whole number and b a counting number.

Ray:

All points on a line which begin at point A and continue indefinitely



Renaming:

Writing a number in a different way; i.e., 1 1/3 = 4/3; 6 2/3 = 5 5/3 etc.

Right angle:

An angle measuring 90°.

Rounding numbers:

Giving an approximation for a number using a specified place value.

Rubber band geometry:

Geometry used in the lower grades whereby rubber bands are stretched over pegs to produce polygonal shapes. (A teaching technique.)

Scale drawing:

A drawing of an object made so that distances in the drawing are proportional to actual distances.

Set:

A group, collection, family, or aggregate of objects. At the least of the concept of set is man's ability to think of a collection of objects as a single entity.

Similar figures:

The same shape but not the same size.

Solid:

All points within a closed surface and all points on that surface.

Solution set:

The set of all numbers which make an open sentence true.

Sphere:

A simple closed surface having all points on the surface the same distance from a given fixed point.

Sub-set:

A set contained in another set. Thus [2, 3] is subset of [1, 2, 3]

Tabulate:

To summarize statistics in a table.

Transversal:

A line that intersects another set of lines in the same plane.

Union of sets:

An operation on sets in which the elements of two sets are joined to form a new set.

Variable:

A letter used to denote any one of a given set of numbers. Another name for variable is placeholder in an equation.

Example:

X + 5 = 7	X is the variable
X + Y = 5	X and Y are variables

Venn diagrams:

Closed curve designs to designate sets with the members represented within.

Whole numbers.

One of the numbers 0, 1, 2, 3, . . . The set of whole numbers consists of 0 and the counting numbers.

CHAPT

"BEHAVIORAL OBJECTIVES"
for
ELEMENTARY MATHEMATICS

All instruction should be based on a set of criteria expressed in the form of purposes, goals, aims, or objectives.

The model behavioral objectives presented in this section are primarily concerned with the cognitive level of learning. These are objectives which emphasize remembering or reproducing something which has been learned, and objectives which involve the solving of some intellective task for which the individual has to determine the essential problem and then reorder given material or combine it with ideas, methods or procedures previously learned. Cognitive objectives vary from simple recall of material learned to highly original and creative ways of combining and synthesizing new ideas and materials. We find that the largest proportion of educational objectives fall into this domain.

The Elementary Mathematics Curriculum Committee wishes to emphasize the importance of cognitive objectives, but does not wish thus to imply that objectives in the affective domain should not be developed. These affective objectives are those which emphasize a feeling, a tone, an emotion or a degree of acceptance or rejection. Affective objectives vary from simple attention to selected phenomena to complex but internally consistent qualities of character and conscience. These objectives are often expressed as attitudes,

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CHAPTER II – OBJECTIVES IN MATHEMATICS

interests, appreciations, values and emotional sets or biases.[2] Objectives in the affective domain are much more difficult to incorporate into the curriculum, but the committee feels that it is important for each school to keep these affective ideas in mind when developing its mathematics program.

The success of an instructional program is dependent on the common understanding of the objectives by the persons who developed the program and the persons who measure the effectiveness of the program. The key is the *clear understanding* of the instructional program and its objectives. Therefore, the objectives used must be stated in a clearly defined form that has little chance of being misinterpreted by anyone.

The use of "behavioral objectives" in curriculum plans is based on this premise. In a mathematics program the objectives should be so stated that there is a definite understanding about the desired goal towards which a child is striving. The objective clearly states the desired performance of the learner and can be clearly measured.

Terminology is important in the writing of behavioral objectives. Words that are used must be meaningful and must eliminate as many misinterpretations as possible. Some words and phrases that should not be used are "to know," "to understand," "to appreciate," and "to believe". These phrases sound fine but are difficult to interpret and evaluate.

[2]Benjamin S. Bloom, *Taxonomy of Educational Objectives*, David McKay Co., New York, 1956.

Some more desirable words and phrases to use are "to recite," "to name," "to write," "to list," "to solve," "to identify," and "to construct." Then there is little question as to what kind of response the learner should exhibit.

In using this approach in a classroom, the plan normally would be to first identify certain concepts that are to be taught. Then a number of behavioral objectives are written for each concept. The objectives are organized in an ordered sequence. As a child moves through this sequence, often on a self-pacing basis, the concept should be learned.

The use of behavioral objectives can best be implemented when a teacher recognizes the fact that a child must be accepted where he is and taken as far as possible. This suggests the need for some form of individualization in the classroom. The technique used in reaching an objective is not as important as the fact that he has learned and can perform the desired response.

A valuable reference for developing an understanding of behavioral objectives is *Preparing Instructional Objectives* by Robert Mager from Fearon Publishers.

Following are some concepts listed as behavioral objectives from an elementary mathematics program. The grade reference is listed only for the purpose of coordination with the preceding Scope and Sequence Chart.

Kindergarten Sample Behavioral Objectives

Given a set of four members (rocks or balls) of varied sizes, the pupil can identify the largest and the smallest when requested to do so.

The pupil can recite the numerals, 0-9, in correct order.

Given two sets with equal number of members the learner can draw lines to show one-to-one correspondence.

The child can identify by name, when given a set of geometric figures, a square, a triangle and a circle.

Given five objects in a row, the pupil can point out which object is first, second, third, fourth, or fifth.

Grade One Sample Behavioral Objectives

The pupil can name all the numerals, 0-100, when asked to do so.

The child can write all the numerals, 0-100, when asked to do so.

The learner can construct simple closed curves, such as circles, squares, and triangles and identify each with the correct name.

The pupil can write correct responses for addition problems with sums less than twenty within a specified period of time.

The pupil can identify the relationship between two numbers and write their relationship, using the following symbols: $>$ $<$ or $=$

Grade Two Sample Behavioral Objectives

The pupil can write all numerals, 0-1000.

The child can write numerals through fifty that result from counting by three's, four's, six's, and ten's.

The learner can name and write symbols for a line, ray and segment.

The pupil can write several names (numerals) for the same number.

A child can make an exchange for a quarter when requested to do so.

Grade Three Sample Behavioral Objectives

The pupil can regroup 4 sets of 3 objects into 3 sets of 4 objects.

The child can write numerals through one million, naming the place value of each numeral. (digits)

Given a multiplication problem of two factors and a product, the learner can write two division problems using the same numerals to indicate the relationship of multiplication to division.

The pupil can construct a bar graph when given data to display.

The child can construct a number line showing fractional parts between 0 and 5, using one-fourth intervals.

Grade Four Sample Behavioral Objectives

The pupil can write numerals in base 2 and base 5 to two-place figures.

The child can identify common denominators for fractions with one-place denominators.

Using clock arithmetic, the learner can write sums for modular addition.

The child can write an example to illustrate the associative property of addition.

The pupil can state a rule for finding the perimeter of a rectangle, square, and triangle.

Grade Five Sample Behavioral Objectives

The pupil can write answers to addition and subtraction problems through millions with eighty percent accuracy when given a test of twenty problems.

The learner can describe a four-place number in expanded notation.

The child can construct an isosceles triangle.

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The pupil can construct scale drawings of a floor plan.

The learner can place in correct order from largest to smallest, a set of six fractions containing one-place denominators.

Grade Six Sample Behavioral Objectives

The pupil can write an example of an open and closed mathematical sentence.

The pupil can write an eight-place whole number in scientific notation.

The child can compute the area of a circle when given the radius or diameter.

The learner can distinguish finite from infinite sets and can give oral examples of each.

The pupil can apply rules for testing congruency of two given triangles.

EVALUATION IN ELEMENTARY MATHEMATICS

Evaluation of mathematics education is a continuous process focused primarily on the growth of children in understandings of (1) the meaning of the number system and the application of this knowledge, (2) the measuring process, and (3) form.

As children progress in the development of mathematical understandings, they grow in their ability (1) to think quantitatively, (2) to solve problems, and (3) to communicate mathematical ideas.

Growth in understandings, abilities, and experiences coupled with success in the use of number leads to an appreciation of the role of mathematics in the enrichment of individual and group living and the extension of effective participation in society.

In order to insure with some degree of certainty that schools are helping children reach these objectives of mathemetics education, three types of evaluation must be carried on. They may be described as follows:

1. Evaluation of individual pupil status and growth both before and after the learning activity.
2. Evaluation of the teaching situation.
3. Evaluation of the mathematics curriculum itself.

Evaluation of pupil status and growth demands first a clear statement of the goals of the mathematics program as exemplified in pupil behaviors. For example, the statement that "ability to communicate using quantitative media as a goal" remains an abstraction which does not lend itself to evaluation. Before it is possible to evaluate the degree to which a given pupil has achieved such a goal, expected behavior demonstrating such achievement must be described. Thus, restating the general goal as "The pupil can develop a graph showing quantitative facts and use it to report data," makes it possible to record the presence or absence of the behavior. Such data, stemming from any observations of various types of expected behaviors at increasing levels of complexity, allow the teacher to form judgments as to the degree to which a given goal is being achieved.

Such behavioral descriptions of all mathematical goals are necessary in order to identify clearly techniques and devices which can be used to secure both objective and judgmental estimates of growth. The evaluative procedures used will vary as the type of achievement under study changes.

Evaluation of knowledge of number is to be done primarily by the teacher. Each step in the learning process should be evaluated immediately following the child's response to what was to be learned. This type of evaluation is continuous throughout the day-by-day learning experiences and includes applications of learning and oral behavior in addition to paper and pencil tests. Inasmuch as the teacher

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may have as many as 35 pupils, more or less, he needs to plan carefully the methods whereby data will be secured. Such planning may include observation, anecdotal records, and the like, as well as tests developed by local districts, teacher-made tests, tests contained in the textbooks studied, and standardized tests.

Children's ability to use concepts concerning quantitative relationships is a major part of evaluation. The teacher observes his pupils in the light of his best understanding of the meaning of quantitative thinking. Teachers should frequently ask pupils to tell how they have reasoned through a mathematical concept or a problem they have solved. Teachers should accept with approval a variety of creative approaches to problem solutions. Pupils may well use objects to illustrate their understanding of concepts. Children's use of mathematics in their other school activities often reveals their degree of understanding. The teaching situation is one of the most important factors contributing to the realization of the goals of the mathematics program. Administrators, supervisors, and teachers of a local district should work together to build the criteria for identifying the characteristics of a good teaching situation and for evaluating classroom procedures.

The questions which follow may direct thinking toward the analysis of important aspects of the program:

1. Are the children grouped within the classroom according to their abilities as shown by tests and observation?
2. Are item analyses made of the tests given to provide a true picture of class achievement?
3. Are the problems and drills suited to the abilities of the children?
4. Are extensive and practical experiences provided?
5. Are the school experiences of the children used to develop number concepts?

6. Are the activities of the classroom used to lend purpose to experience with numbers?
7. Is the classroom mathematics program related to the out-of-school use of numbers?
8. Is ample opportunity provided for the children to acquire skill in the use of numbers?
9. Is drill provided in situations that make it meaningful to the children?
10. Are the special interests of individuals used to motivate their work?
11. Is a careful diagnosis made of the arithmetic disabilities of individuals who are not achieving according to their intelligence potentials?
12. Is each child kept informed as to his progress and next steps in procedure?
13. Do the children show growth in accordance with their ability as measured by a standardized test?

An extremely important phase of evaluation of the mathematics education program is an examination of the curricular plan itself. This involves not only study of the mathematics course of study but also analysis of the total educational plan for a given school or school system as it relates to mathematics education.

Such evaluation is, of course, dependent in part on the data resulting from evaluation of individual status and progress and from analysis of the teaching situation. Data from these sources are invaluable in developing more adequate mathematics programs. But to stop short at this point in evaluation may have disastrous results on the future evolution of the program itself.

In order that desirable changes in and additions to the mathematics program may be insured, a thorough, ongoing

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program of evaluation must give attention to such items as the following:

1. Are the possibilities for mathematical growth present in other subject areas being fully used as a planned part of the mathematics program?
2. Are new developments in the field of mathematics being incorporated when and where appropriate?
3. Are elements no longer useful or desirable being dropped from the mathematics program?
4. Are items within the program correctly placed in terms of efficiency of teaching-learning and of functional use?
5. Is the content of the mathematics program consistent with the demands upon individuals as they live in a dynamic society?
6. Are the teaching tools such as study guides, textbooks, and manipulative materials provided in sufficient quantity and quality to allow for achieving the goals sought?
7. What proportion of the pupils elect to continue in high school their interest in and study of mathematics?
8. What are the judgments of experts in mathematics education about the program?

A clear statement of the goals of the mathematics program and a continuous program of evaluation of the three types described should contribute to the improvement of mathematics teaching.[3]

[3]California State Department of Education, *Looking Ahead In Mathematics*, 1961.

The Elementary Mathematics Curriculum Committee believes that this guide should include a Resource Section, to be used by teachers to find sources of materials such as books, A-V materials, manipulative devices, etc.

The Resource Section, by necessity, is dated. The ongoing development of such materials will cause the materials themselves, the prices, and the sources to be subject to continued change. In order to keep up with the changes that are occurring in material development in mathematics, the committee suggests that catalogues and brochures be obtained from the various companies listed. It is possible for schools to be placed on mailing lists developed by these companies to provide information about current materials available from them.

The Wyoming State Department of Education strives to maintain current descriptive information regarding these materials and will provide this to schools or teachers, upon request.

Using Concrete Materials With Children:

Children's participation in activities to develop mathematical understanding is basic to a modern mathematics program for primary grades. In such a program, the children are challenged to use concrete materials in carefully selected activities that enable them to see patterns, to discover relationships, and to enrich understandings.

CHAPTER III – RESOURCES FOR TEACHERS

This manipulation of concrete materials is of major importance in the introductory experiences of the learning program. It provides the bridge between the child's previous informal experience with number concepts, most of which were concrete experiences, and his first step into an organized program of learning experiences in mathematics.

The appropriateness of the concrete materials, and the way in which they are used, determine to a large extent the initial success of the learning experiences for the children. General suggestions for the selection and use of concrete materials are given below. The materials listed should be considered as examples. You should feel free to select similar materials that can be used in a way that parallels the suggestions for carrying out the activities.

Materials for use in recognizing patterns:

Objects that are to be used for class demonstration at the front of the room should be large enough to be seen by all the children. Objects suitable for class demonstrations may be cutouts of stars, bells, flowers, or animals. If these cutouts are to be used on the flannel board, they should be cut from felt or flannel. If paper or cardboard cutouts are used on the flannel board, they should be light in weight and should be backed by small pieces of sandpaper to hold them to the flannel board.

If cutouts or small toys are to be placed on the chalkboard, a small dab of plastic adhesive should be

placed on each object. Any one of several brands of plastic adhesive may be used. When using plastic adhesive to attach objects to the chalkboard, it is important to remember that the chalkboard should be as free of chalk dust as possible.

You may prefer to make simple line drawings on the board of objects to be used in class demonstrations.

Among the objects that are appropriate for individual children to use at their desks are beads of uniform size and shape and shoestrings, and colored counting blocks of uniform size and shape. It may be desirable to have available small gummed pictures of stars, hearts, trees, birds, animals, or fruit. These gummed pictures, in various colors, may be used by children to show patterns. For example, a child may make a pattern, using an apple, an orange, a pear, an apple, an orange, a pear, and so on.

If pegboards are available, a supply of pegs in various colors should be provided. Pegboards may be used by individual children or by a small group of children who find it difficult to recognize patterns. They can remove the pegs and begin arranging the pattern again without the frustration of having made a mistake that is difficult to correct. Other children may be able to use a pegboard and pegs to discover other patterns.

Materials for use in understanding sets:

Two types of objects are needed for use in developing an understanding of sets. Some of the objects (cutouts, pictures) should be large enough for class demonstration purposes. Other objects (small counting objects) should be available in quantity and should be small enough for use by individual children at their desks.

There should be a variety of objects so that comparisons can be made of the number of objects in 2 or 3 sets with as many as 10 objects in each set. The

cutouts or pictures should be suitable so that the objects in one set can be matched one-to-one with the objects in another set.

Children may also be used in the class demonstration. The children may be matched one-to-one with hats, toys, chairs, books, scissors, and other objects that are available in the classroom.

Small objects such as counting sticks, milk straws, buttons, small bottle caps, golf tees, plastic ice-cream spoons, or small counting cubes may be provided each child. Each child should have enough objects for several sets with as many as 10 objects in each set.

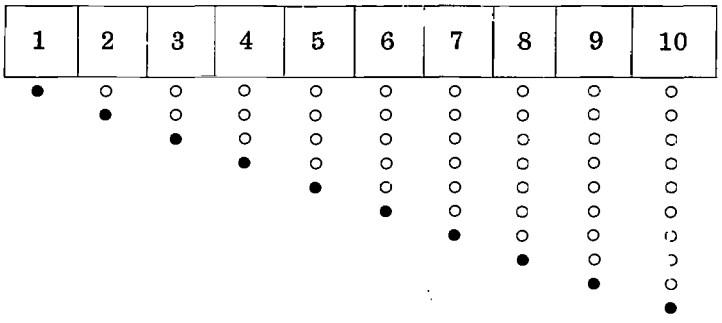
Materials needed for developing the cardinal numbers one through ten:

The materials suggested for use in developing an understanding of sets and in comparing the number of objects in sets may be used in developing the cardinal numbers one through ten.

In addition to the materials for demonstration purposes and those for use by individual children at their desks, oak tag, cardboard, or art paper will be needed for making classroom charts. Cardboard or art paper will also be used in a matching game for each child that includes cards with pictures of sets of objects, ranging in number of objects from zero to ten in a set, and cards for the numerals 1 through 10 and 0 to be matched with the cards having pictures of sets of objects.

One chart will be made for the numbers one through ten. A large numeral is written on the chart and pictures of sets that show the number of objects named by the numerals are placed next to it. The children will draw the pictures or collect pictures of objects and mount them on the chart as each new numeral is introduced and the meaning of the number is understood.

Another classroom chart, designed to develop an understanding of the number sequence, is suggested below. This chart can be used to show in a visual way that each new numeral added to the chart names a number that is one more than the number named by the preceding numeral on the chart. When the meaning of a number is developed, the numeral for the number will be written on the chart and the appropriate number of objects will be drawn or placed on the chart below the numeral:



In planning the cards for the matching game, the oak tag, cardboard, or art paper should be cut to a size that can have as many as ten objects on a card. The cards on which the numerals are to be written need not be as large. However, each of the numeral cards should be the same size for ease of handling and stacking. The numeral cards may be a different color than the cards with the pictures of sets. It is important that the numerals that are placed on the charts are the hand-written models of the numerals that the children will be taught to write later in the program.

Materials needed for learning about measurement:

Pictures of objects that are generally measured by linear measure will be needed. These objects should

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include only those objects that can be compared to find the longer or the shorter and the taller or the shorter of two objects, or the longest or the shortest and the tallest or the shortest of more than two objects.

In addition to pictures of objects to be compared, sticks or blocks of various lengths will be needed. Blocks should be compared by inspection first to find which is longer or which is shorter. Then they can be measured informally with a piece of string or a strip of cardboard to see if the conclusion reached was correct. The children should find the stick that is longer or shorter, but not how much longer or shorter, at this learning level. In this way, the children develop some understanding of basic ideas about measurement.

Materials needed for learning about geometric shapes:

Materials will be needed to help children make models of squares, rectangles, triangles, and circles. Pieces of cardboard cut into these shapes, some large and some small, may be provided so that children can trace around them to make pictures of the shapes. Wire can be bent around these shapes to make models. Paper plates, coasters, lids from jars, and plastic containers may be used. Small toys such as blocks, dishes, and checkers may also be used to draw pictures of the geometric shapes.

Pictures of objects that have the shape of a square, a rectangle, a triangle, or a circle may be collected. The children may find such pictures in magazines, in books, or in sales catalogs that have been discarded. The pictures may be cut out and mounted on cardboard or art paper for display in the classroom.

Books for Primary Children:

There are many books written for children in the primary grades that emphasize number concepts.

Following is a list of some of the books that are generally found in elementary school libraries or in the children's section of public libraries:

Bishop, Claire H. *The Five Chinese Brothers.* New York; Coward McCann, Inc., 1938

Brann, Esther. *Five Puppies for Sale.* New York: The Macmillan Co., 1948

DeRegniers, Beatrice S. *Cats Cats Cats Cats Cats.* New York: Pantheon Press, 1958

Duvoisin, Roger. *Two Lonely Ducks.* New York: Alfred A. Knopf, Inc., 1955

Elkin, Benjamin. *Six Foolish Fishermen.* Chicago: Children's Press, Inc., 1959

Hoberman, Mary Ann and Norman. *All My Shoes Come in Two's.* Boston: Little, Brown & Co., 1957

Kepes, Juliet. *Two Little Birds and Three.* Boston: Houghton Mifflin Co., 1960

Kravetz, Nathan. *Two for a Walk.* New York: Henry Z. Walck, Inc. 1954

Krum, Charlotte. *Four Riders.* Chicago: Follett Pub. Co., 1953

LeSieg, Theodore. *Ten Apples up on Top!* New York: Random House, Inc., 1961

Milne, A. A. *The World of Christopher Robin.* New York: E. P. Dutton & Co., 1959

Moore, Lilian. *My First Counting Book.* New York: Golden Press, Inc. 1961

Schlein, Miriam. *The Four Little Foxes.* New York: William Scott, Inc., 1953

Scott, Louise, and J. J. Thompson, *Rhymes for Fingers and Flannelboards.* St. Louis, Mo.: Webster Pub. Co., 1960

Selective Education Equipment (S. E. E.) Inc. 3 Bridge St. Newton, Massachusetts 02195 (A wide variety of primary books covering mathematical topics). See catalog.

Slobodkin, Louis. *One Is Good but Two Are Better.* New York: Vanguard Press, Inc., 1954

Tudor, Tasha. *1 is One.* New York: Henry Z. Walck, Inc., 1956

Watson, Nancy. *What Is One?* New York: Alfred A. Knopf, Inc., 1954

Books for Intermediate Children:

Adler, Irving. *The Giant Golden Book of Mathematics.* New York: Golden Press, 1958. (92 pp.) (6 and up)

Andrews, F. E. *New Numbers.* New York: Harcourt, Brace & Co., 1935. (168 pp.) (6)

Beckhard, Arthur. *Albert Einstein.* New York: G. P. Putnam's Sons, 1959. (126 pp.) (5-9)

Bell, Thelma. *Snow.* New York: Viking Press, 1954 (54 pp.) (3-7)

Boehm, David Alfred, and Reinfold, Fred. *Coinmetry.* New York: Sterling Publishing Co., 1952. (93 pp.) (4-8).

Brades, Louis Grant. *Math Can Be Fun.* Portland, Maine: J. Weston Walch, 1956. (200 pp.) (5 and up)

Brindze, Ruth. *The Story of Our Calendar.* New York: Vanguard Press, 1949. (64 pp.) (4-7)

Brindze, Ruth. *Johnny Get Your Money's Worth.* New York: Vanguard Press, 1938. (230 pp.) (4-6)

Buff, Mary and Conrad. *Big Tree.* New York: Viking Press, 1946. (80 pp.) (5-9)

Carlson, Bernice W. *Make It and Use It.* Nashville: Abingdon Press, 1958. (160 pp.) (3-5)

Crocker, Betty. *Betty Crocker's Cook Book for Boys and Girls.* New York: Golden Press, 1957. (191 pp.) (4-6)

Fenton, Carroll L. and Mildred A. *Worlds in the Sky.* New York: John Day Co., 1950. (4-7)

Flynn, Harry Eugene, and Lund, Chester Benford. *Tick-Tock,* A Story of Time. Boston: D.C. Heath and Co., 1938. (234 pp.) (3-4)

Foster, Constance J. *The Story of Money.* New York: McBride Co., 1950. (205 pp.) (5-8)

Fowler, H. Walter, Jr. *Kites.* New York: Ronald Press Co., 1953. (92 pp.) (5-6)

Freeman, Mae and Ira. *Fun with Astronomy.* New York: Random House, 1953. (57 pp.) (4-6)

Freeman, Mae Blacker. *The Story of Albert Einstein: The Scientist Who Searched Out the Secrets of the Universe.* New York: Random House, 1958. (178 pp.) (5-9)

Galt, Thomas Franklin. *Seven Days from Sunday.* New York: Thomas Y. Crowell Co., (215 pp.) (5-9)

Henry, Thomas. *Charles Steinmetz.* New York: G. P. Putnam's Sons, 1959. (126 pp.) (5-9)

Higgins, Loyta. *Let's Save Money.* New York: Golden Press, 1958. (18 pp.) (3-4)

Hogben, Lancelot. *The Wonderful World of Energy.* New York: Doubleday & Co., 1957. (69 pp.) (5-9)

Huffman, Peggy. *Miss B's First Cookbook.* Columbus, Ohio: Charles E. Merrill Co., 1950. (43 pp.) (3-4)

'ee. New York: Viking

and Use It. Nashville: (3-5)

'ook Book for Boys and 957. (191 pp.) (4-6)

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ays from Sunday. New 15 pp.) (5-9)

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l World of Energy. New 9 pp.) (5-9)

Cookbook. Columbus, 0. (43 pp.) (3-4)

Kiene, Julia. *The Step-by-Step Cookbook for Girls and Boys.* New York: Golden Press, 1950. (125 pp.) (4-6)

Lach, Alma S. *A Child's First Cookbook.* New York: Hart Publishing Co., 1956. (96 pp.) (3-4)

Larsen, Harold D. *Enrichment Program for Arithmetic.* Evanston, Illinois: Row, Peterson & Co., 1956. (3-8)

Lauber, Patricia. *The Quest of Galileo.* New York: Doubleday & Co., 1959. (56 pp.) (2-6)

Leeming, Joseph. *Fun with Puzzles.* Philadelphia: J. B. Lippincot. Co., 1946. (128 pp.) (4 and up)

Leeming, Joseph. *More Fun with Puzzles.* Philadelphia: J. B. Lippincott Co., 1947 (149 pp.) (3 and up)

Leeming, Joseph. *From Barter to Banking.* New York: Appleton-Century-Crofts, 1940. (131 pp.) (5-6)

Maloney, Terry. *The Story of Maps.* Buffalo: Sterling Pub. Co., 1959. (48 pp.) (3-7)

Malter, Morton S. *Our Largest Animals.* Chicago: Albert Whitman & Co. 1958. (31 pp.) (3-6)

Malter, Morton S. *Our Tiniest Animals.* Chicago: Albert Whitman & Co., 1955. (32 pp.)(3-4)

Marshak, Ilin. *What Time Is It?* Philadelphia: J. B. Lippincott Co., 1932. (5-6)

Massoglia, Elinor. *Fun-Time Paper Folding.* New York: Grosset & Dunlap, 1959. (31 pp.) (4-6)

McCloskey, Robert. *Time of Wonder.* New York: Viking Press, 1957. (63 pp.) (4-6)

Moore, Lillian. *The Important Pockets of Paul.* New York: David McKay Co., 1954. (73 pp.) (3-6)

Moore, Patrick. *Isaac Newton.* New York: G. P. Putnam's Sons, 1958. (124 pp.) (4-7)

Neal, Harry E. *The Story of the Kite.* New York: Vanguard Press, 1954. (4-6)

Neurath, Marie. *Too Small to See.* Buffalo: Sterling Pub. Co., 1957. (36 pp.) (4-6)

Newell, Homer E., Jr. *Space Book for Young People.* New York: McGraw-Hill Book Co., 1958. (114 pp.) (3-7)

Norman, Gertrude. *The First Book of Music.* New York: Franklin Watts, 1954. (65 pp.) (3-6)

Parker, Bertha Morris. *Golden Book of Science.* New York: Golden Press, 1956. (98 pp.) (5-7)

Parker, Bertha Morris. *Heat.* Evanston, Ill: Row, Peterson & Co., 1942. (36 pp.) (5-6)

Perkins, Wilma Lord. *Fannie Farmer Junior Cook Book.* Boston: Little Brown & Co., 1957. (208 pp.) (5-9)

Rombauer, Irma. *Cookbook for Girls and Boys.* Indianapolis: Bobbs-Merrill Co., 1952. (243 pp.) (4-8)

Saxon, G. R. *How Fast?* New York: Thomas Y. Crowell Co., 1954. Unpaged. (5-6)

Sharp, Elizabeth N. *Simple Machines and How They Work.* New York: Random House, 1959. (96 pp.) (3-5)

Smith, David Eugene. *Number Stories of Long Ago.* New York: Scripta Mathematica, 1955. (5 and up)

Smith, David Eugene. *The Wonderful Wonders of One-Two-Three.* New York: Scripta Mathematica, 1937. (47 pp.) (3 and up)

Sootin, Laura. *Let's Go to a Bank.* New York: G. P. Putnam's Sons, 1957. (47 pp.) (4-6)

Tannenbaum, Beulah, and Stillman, Myra. *Understanding Maps.* New York: McGraw-Hill Book Co., 1957. (144 pp.) (5-8)

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lo: Sterling Pub.

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ew York: G. P.

a. *Understanding* Co., 1957. (144

Thurber, James. *The Great Quillow.* New York: Harcourt, Brace & World, 1944. (55 pp.) (3-7)

Thurber, James. *Many Moons.* New York: Harcourt, Brace & World, 1943. (42 pp.) (3-6)

Townsend, Herbert. *Our Wonderful Earth.* Rockleigh, N.J. Allyn & Bacon, 1950. (152 pp.) (3 and up)

Valens, Evans G. *Me and Frumpet: An Adventure with Size and Science.* New York: E. P. Dutton & Co., 1958 (128 pp.) (4-6)

Werner, Elisa Jane. *The Golden Geography Book.* New York: Golden Press, 1952. (96 pp.) (4-6)

Wyler, Rose and Ames, Gerold. *The Golden Book of Astronomy.* Revised edition. New York: Golden Press, 1959. (97 pp.) (5-7)

Zarchy, Harry. *Let's Make Something.* New York: Alfred A. Knopf, 1941. (158 pp.) (3-7)

Zim, Herbert S. *The Sun.* New York: William Morrow & Co., 1953. (Unpaged) (3-7)

Films

Equations:

Helps young students understand and correctly use equations to express the equality relation between numbers.

Code 404202-L. C. FiA 68-308
12 minutes—color—$169.00
Rental: $10.00 (McGraw-Hill)

Inverse Operations:

Will help youngsters understand and use the inverse relation between the addition and subtraction operations.

Code 404206-L. C. FiA 68-310
12 minutes—color—$160.00
Rental: $10.00 (McGraw-Hill)

Associativity:

Aids children in gaining an understanding of the associative property and to apply it in a variety of addition situations.

Code 404205-L. C. FiA 68-298
12 minutes—color—$160.00
Rental: $10.00 (McGraw-Hill)

Commutativity:

Demonstrates that addition is commutative but subtraction is not. Use of the commutative property to make learning of addition facts easier is stressed.

Code 404204-L. C. FiA 68-307
12 minutes—color—$160.00
Rental: $10.00 (McGraw-Hill)

Inequalities:

Shows inequality relations between numbers, and teaches children to express these relations in symbolic form. A contrast is made between equality and inequality.

Code 404203-L. C. FiA 68-309
12 minutes—color—$160.00
Rental: $10.00 (McGraw-Hill)

Sets and Numbers:

Helps young children gain an understanding of sets, one-to-one correspondence, cardinal numbers, numerals, and counting.

Code 4-4201-L. C. FiA 68-315
12 minutes—color—$160.00
Rental: $10.00 (McGraw-Hill)

Introducing Graphs:

With the use of animation this interesting educational film presents a comprehensive examination of several common graphs and their functions. Employing the example of a person buying a home the following graphs are illustrated: picture, bar and line graphs. The film then proceeds to show that graphs represent visually a selection of related facts simply and concisely.

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Filmstrips

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Code 611994-L. C. FiA 67-1605
11 minutes—B & W—$65.00
Code 611995—L. C. FiA 67-1605
11 minutes—color—$130.00
Rental: $10.00 (McGraw-Hill)

The Meaning of Percentage:

Develops the meaning of percentage, and relates percentage to hundredths both as fractions and as decimals, using graphic representations.

Code 400273—L. C. FiA 52-269
10 minutes—B & W—$60.00
Rental: $6.50 (McGraw-Hill)

SUPPLIERS

Central Scientific Co., 2600 S. Kostner Avenue, Chicago, Ill. 60623

Davis Audio-Visual, Inc., 1801-07 Federal Blvd., Denver, Colo. 80204

Math-U-Matic, Inc., 607 West Sheridan, Oklahoma City, Okla.

McGraw-Hill Films, 330 West 42nd St., New York, N.Y. 10036

Mincom Division 3M Co., 3M Center, St. Paul, Minnesota 55101

Society for Visual Education, Inc., 1345 Diversey Parkway, Chicago, Ill. 60614

Filmstrips

Using Modern Mathematics—Group 1-1 Develops the concepts of using and understanding numbers one to twelve. Bright, interesting illustrations are used to teach the child to recognize small sets (groups) without counting. (Society for Visual Education, Inc.) 531-SA—Set of 5 captioned filmstrips—$27.00.

Using Modern Mathematics—Group 1-2 Teaches the concepts relative to sets eleven to twenty. "Teen" numbers are formed by associating a set of ten objects

with a few others (sets and subsets). Equivalence and non-equivalence of sets and one-to-one correspondence are taught. 531-SB—Set of 6 captioned filmstrips—$33.00. (Society for Visual Education, Inc.)

Using Modern Mathematics—Group 2 Develops ease in counting by 2's, 3's, 4's, and 5's. Students gain facility in handling simple addition and subtraction facts and combinations, and multiplication and division facts and combinations. 531-SC—Set of 6 captioned filmstrips—$33.00 (Society for Visual Education, Inc.)

Using Modern Mathematics—Group 3 Teaches basic understanding of the way in which our number system is structured and how to employ this understanding in basic arithmetical operations of adding, subtracting, multiplying and dividing. 537-SD—Set of 8 captioned filmstrips—$44.50 (Society for Visual Education, Inc.)

Using Modern Mathematics—Group 4 Develops understanding of sets; explains commutative, associative principles, use of number line, open and closed sentences, base 10. 532-SA—Set of 8 captioned filmstrips—$44.50. (Society for Visual Education, Inc.)

Using Modern Mathematics—Group 5 Enrichment and understanding are provided through the use of number lines and open and closed sentences. For easy step-by-step learning. 532-SB—Set of 8 captioned filmstrips—$44.50. (Society for Visual Education, Inc.)

Using Modern Mathematics Group 6 Continues development of basic principles of modern mathematics. Teacher-planned illustrations aid understanding of abstract concepts. 532-SC—Set of 8 captioned filmstrips—$44.50. (Society for Visual Education)

Understanding Fractions—Goes beyond textbook by illustrating common applications of fractions through vivid color pictures. 530-S—Set of captioned filmstrips—$43.20. (Society for Visual Education, Inc.)

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Per Cents and Percentage—Original color drawings with captions correlate per cents with familiar situations. 539-S—Set of 7 captioned filmstrips—$37.80. (Society for Visual Education, Inc.)

Decimals and Measurements—Skillful illustrations of familiar objects and situations present principles of decimals. 538-S—Set of 7 captioned filmstrips—$34.65. (Society for Visual Education, Inc.)

Introduction of Fractions—Series No. 1030 These five color filmstrips present effectively the beginning concepts of fractions. Complete series in color—$26.25. (Davis Audio-Visual, Inc.)

Using Modern Mathematics (Grades 1-6)—Modern Math for the elementary and middle grades. Lively full-color illustrations, and explicit captions explain the new mathematics principles. 59287-1 Set of 5 filmstrips—$27.00. (Central Scientific Co.)

Arithmetic Combinations (Grades 1-6) These 16 filmstrips help develop number recognition skill by strengthening association of number symbols with number names. 59290-5—$28.80. (Central Scientific Co.)

Building Concepts in Mathematics (Grades 5-9)—This series introduces the concept of fractions, numbers, and proper terminology, followed by development of computation processes. 58701-019—Complete set of 6—$36.00 (Central Scientific Company.)

Manipulative Devices[4]

The scope and variety of manipulative devices are currently of such a magnitude that the Curriculum Committee has merely attempted to classify these materials into broad categories.

[4]Patricia S. Davidson, *An Annotated Bibliography of Suggested Manipulative Devices.* The Arithmetic Teacher, October, 1968.

Following the representative category is a listing of companies which supply these materials. At the end of the section are the addresses of these companies.

The committee recommends that the individual teachers or administrators write for complete catalogs, brochures and price lists where manipulative materials are desired.

Blocks, Cubes and Rods:

Cuisenaire Company of America
E.T.A. School Materials Division
General Learning Corp. Early Learning Division
Herder and Herder
Houghton Mifflin Co.
Math Media Division, H & M Associates
S.E.E.
Webster Division, McGraw Hill Book Co.

Calculating Aids (Abacus sets, calculators, counting frames, slide rules):

Childcraft Equipment
General Learning Corp. Early Learning Division
Houghton Mifflin
Ideal
Lano Co.
Math Media Division, H & M Associates
Pickett Co.
S. E. E.
Schoolhouse Visuals, Inc.

Cards:

General Learning Corp. Early Learning Division
Holt, Rinehart & Winston
Ideal
Instructo
Math Media Division, H & M Associates
S. E. E.
S. R. A.
Webster Division, McGraw Hill Book Co.

Construction, Geometry and Measurement Aids:

Academic Industries
Childcraft Equipment Co.
Creative Playthings
Edmund Scientific Co.
Frederick Post Co.
Geyer Instructional Aids
Houghton Mifflin Co.
Ideal
Instructo
Kindrey Manufacturing Co.
Math Media Division, H & M Associates
S. E. E.
Sigma Enterprises
Walker Teaching Programs and Teaching Aids

Games and Puzzles:

Childcraft Equipment Co.
Concept Co.
Creative Playthings
Dover Publications
Edmund Scientific Co.
E. S. Lowe Co.
Ideal
Imout
Instructo Kohner Brothers, Inc.
Krypto Corp.
Math Media Division, H & M Associates
Miles Kimball Co.
3 M Co.
S. E. E.
Scott Foresman Co.
Tuf
Webster Division, McGraw Hill Book Co.
Wff'N Proof
World Wide Games

Miscellaneous Items: Balances, Charts, Counting Aids, Drill Materials, Graphs, Flannel Boards, and Number Lines.

Edmund Scientific Co.
Edukaid of Ridgewood
General Learning Corp. Early Learning Division
Houghton Mifflin Co.
Ideal
Instructo
Math-Master Labs, Division of Games Industries
Math Media Division, H & M Associates
Schoolhouse Visuals, Inc.
S. E. E.
Study-Scope Company

Models:

Creative Playthings
Edmund Scientific Co.
General Learning Corp.
Herder & Herder
Houghton Mifflin Co.
Ideal
LaPine Scientific Co.
Math-Master Labs, Division of Games Industries
Math Media Division, H & M Associates
National Council of Teachers of Mathematics
S. E. E.

Suppliers

Academic Industries, Inc.
1754 Walton Avenue
Bronx, New York 10453

Childcraft Equipment Company, Inc.
155 East 22nd Street
New York, New York 10010

Concept Company
P.O. Box 273
Belmont, Massachusetts 02178

Creative Playthings, Inc.
Princeton, New Jersey 08540

Cuisenaire Company of America, Inc.
9 Elm Avenue
Mount Vernon, New York 10550

Dover Publications
1 East 2nd Street
Mineola, New York 11501

Edmund Scientific Company
100 Edscorp Building
Barrington, New Jersey 08007

Edukaid of Ridgewood
Ridgewood, New Jersey 07450

E. T. A. School Materials Division
159 East Kinzie Street
Chicago, Illinois 60610

Frederick Post Company
Chicago, Illinois 60690

General Learning Corp. Early Learning Divisi
Three East Fifty Fourth Street
New York, N. Y. 10022

Geyer Instructional Aids Company
1229 Maxine Drive
Fort Wayne, Indiana 46807

Herder and Herder, Inc.
232 Madison Avenue
New York, New York 10016

Holt, Rinehart and Winston, Inc.
383 Madison Avenue
New York, New York 10017

Houghton Mifflin Company
1900 South Batavia Avenue
Geneva, Illinois 60134

Ideal School Supply Co.
11000 South Lavergne Avenue
Oak Lawn, Illinois 60453

Imout Arithmetic Drill Games
706 Williamson Building
Cleveland, Ohio 44114

The Instructo Corporation
Paoli, Pennsylvania 19301

Kindrey Manufacturing Company
P. O. Box 11606
Palo Alto, California 94306

Kohner Brothers, Inc.
Tryne Game Division
P. O. Box 294
East Paterson, New Jersey 07407

Krypto Corporation
2 Pine Street
San Francisco, California 94111

Lano Company
4741 West Liberty Street
Ann Arbor, Michigan 48102

LaPine Scientific Company
6001 South Knox Avenue
Chicago, Illinois 60629

E. S. Lowe Company, Inc.
27 West 25th Street
New York, New York 10010

Math-Master Labs
Division of Gamco Industries, Inc.
Box 310
Big Spring, Texas 79720

Math Media Division
H and M Associates
P. O. Box 1107
Danbury, Connecticut 06810

Miles Kimball Company
41 West Eighth Avenue
Oskkosh, Wisconsin 54901

Minnesota Mining and Manufacturing Company (3M Co.)
St. Paul, Minnesota 55119

National Council of Teachers of Mathematics (NCTM)
1201 Sixteenth Street, N. W.
Washington, D. C. 20036

Pickett, Inc.
Pickett Square
Santa Barbara, California 93102

Schoolhouse Visuals, Inc.
1629 K St., N. W.
Suite #5061
Washington, D. C. 20006

Science Research Associates, Inc. (S. R. A.)
259 East Erie Street
Chicago, Illinois 60611

Scott, Foresman and Company
1900 East Lake Avenue
Glenview, Illinois 60025

Selective Educational Equipment (S. E. E.), Inc.
3 Bridge Street
Newton, Massachusetts 02195

Sigma Enterprises, Inc.
Box 15485
Denver, Colorado 80215

Study-Scope Company
319 East Front Street
Tyler, Texas 75701

TUF
P.O. Box 173
Rowayton, Connecticut 06853

Walker Teaching Programs and Teaching Aids
720 Fifth Avenue
New York, New York 10019

Webster Division
McGraw-Hill Book Company
Manchester Road
Manchester, Missouri 63011

Wff'n Proof
P. O. Box 71
New Haven, Connecticut 06501

World Wide Games
Delaware, Ohio 43015

Programmed Instruction Materials

Adding and Subtracting Like Fractions, M-73, Grade 5-6, Fractions with common denominator. Field Enterprises Educational Corp.

Addition and Subtraction Facts—Grade 1-3, Involves numerals 10 and smaller. Grolier Educational Corp.

Addition of Like Fractions, Grade 5, Numerator and denominator terms, rules, and techniques, Graflex, Inc.

Addition Facts for 1's, 2's, 3's, M-5-6: Grades 2-3—Field Enterprises Educational Corp.

Addition Facts for 4's, 5's, 6's, M-7-8; Grades 2-3; Field Enterprises Educational Corp.

Addition Facts for 7's, 8's, 9's, M-9-10; Grades 2-3; Field Enterprises Educational Corp.

Addition Terms, Grade 3-4, Addition problems, addends, mathematical signs; M-11, Field Enterprises Educational Corp.

Arithmetic, 4003; Grades 4-6; Addition, subtraction, multiplication, division, fractions, decimals; Dav-Pro, Advertising Corp.

ıing Aids

Arithmetic I and II, Grades 4-5; Central Scientific Company

Arithmetic Facts, Book I, Grades 2-5; Regular and mixed addition and subtraction facts on different levels of difficulty, algebraic and verbal statements; Graflex, Inc.

Arithmetic Facts, Book 2, Grades 2-5; Multiplication and division facts at different levels of difficulty, algebraic or as verbal statements; Graflex, Inc.

Arithmetic Fundamentals: Addition, Grade 5; Whole numbers, like fractions, unlike and related fractions, decimals; The Welch Scientific Co.

Arithmetic Fundamentals: Addition; Grade 6; whole numbers, like and unlike fractions; The Welch Scientific Company

ıs, M-73, Grade 5-6,
r. Field Enterprises

Arithmetic Fundamentals—Addition Series A-B, C, D, E-F, and G; Grades 3-6, Whole numbers, fractions mixed numbers, zero, percents, decimal fractions. California Test Bureau.

rade 1-3, Involves
ational Corp.

Arithmetic Fundamentals—Multiplication; One, two, and three-place multipliers; The Welch Scientific Co.

5, Numerator and
iques, Graflex, Inc.

3: Grades 2-3—Field

Arithmetic Fundamentals—Multiplication Grade 6; whole numbers, fractions, fractions, decimals, measures, percents. The Welch Scientific Co.

8; Grades 2-3; Field

Arithmetic Fundamentals—Multiplication Series A-B, C, D, E-F, and G; Grades 3-6, Money values, zero, mixed numbers, cancelling, decimal fractions, percents. California Test Bureau.

0; Grades 2-3; Field

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Arithmetic Fundamentals—Subtraction Grade 5; whole numbers, like fractions, unlike and related fractions, decimals to 100th's; The Welch Scientific Co.

dition, subtraction,
decimals; Dav-Pro,

Arithmetic Fundamentals—Subtraction Grade 6; whole numbers, money, fractions, decimals, measures. The Welch Scientific Co.

Arithmetic Fundamentals—Subtraction Series A-B, C, D, E-F, and G; Grades 3-6; money values, mixed numbers, zero, least common denominator. California Test Bureau.

Arithmetic in Use—Grade 5; new mathematical concepts, number lines, Noble and Noble Publishers, Inc.

Arithmetic of the Whole Numbers—Grade 6; symbols and terminology of the four arithmetic operations; Encyclopaedia Britannica, Educational Corp.

Arithmetic With Sets, Grade 4; new mathematical concepts; number lines; Noble and Noble Publishers, Inc.

Carrying in Addition, M-12; Grades 3-4; carry of regroup in addition from the 1's place to the 10's place and 10's place to 100's; Field Enterprises Educational Corp.

Carrying in Multiplication, M-31; Grade 4; carry from 1's place to 10's place to 100's place with 1 place and 2 place multipliers; Field Enterprises Educational Corp.

Changing Decimals to Fractions, M-86; Grade 6; how to change decimal fractions of 10ths, 100th's and 1,000th's to common fractions; Field Enterprises Educational Corp.

Changing Fractions to Decimals, M-89; Grade 6; How to change common fractions to decimal fractions; Field Enterprises Educational Corp.

Column Addition, Its Method and Check—Arithmetic U-3008, Unit 4; Grades 2-6; Column addition, carrying and checking in addition; Dav-Pro, Advertising Corp.

Column Subtraction and Checking—Arithmetic, U-3008, Unit 6; Grades 2-6; Subtraction with three place numbers, using zeros; "borrowing" or "exchanging." Dav-Pro, Advertising Corp.

Comparing Fractions, M-69; Grades 4-6; how to compare the different denominators of fractions that name one part to determine which fraction is larger; Field Enterprises Educational Corp.

Comparing Sets, M-3; Grades 3-4; Equal or not equal sets; Field Enterprises Educational Corp.

Contemporary Mathematics, Bases 1; Grades 3-4; The Welch Scientific Company.

Contemporary Mathematics, Bases 1; Grades 3-4; The Welch Scientific Company.

Contemporary Mathematics, Bases 2; Grades 3-4; The Welch Scientific Company.

Contemporary Mathematics Sets and Sets Symbols; Grades 3-4; The Welch Scientific Company.

Decimal Numbers; Grades 4-6; Addition, subtraction, multiplication, and division of decimal numbers; Grolier Educational Corp.

Decimals and Per Cents; Grades 5-6; Meaning of percentage, changing decimals to percents and percents to decimals; Allyn and Bacon, Inc.

Decimals: Arithmetic, U-3008, Unit 12; Grade 2-6; decimals, place value; fractions; Dav-Pro, Adv. Corp.

Distance, Rate, and Time, M-59; Grade 6; how to find distance something travelled, its rate, or the time it takes something to travel, formulas. Field Enterprises Educational Corp.

Dividing by Decimals, M-88; Grade 6; how to move decimal point and how to use zero when dividing by a decimal number; Field Enterprises Educational Corp.

Dividing Decimals, M-87; Grade 6; where to place decimal point in an answer; how to use zero when dividing a decimal by a whole number; Field Enterprises Educational Corp.

Dividing Fractions, M-78; Grades 5-6; How to divide fraction by a fraction and a whole number by a fraction; Field Enterprises Educational Corp.

Division: Arithmetic, U-3008, Unit 9, Grade 2-6; Division by 2, 3, and 4; Dav-Pro, Advertising Corp.

Division: Arithmetic, U-3008, Unit 10, Grades 2-6; division by 5, 6, 7, 8, 9 and 10; division with remainders; Dav-Pro Advertsiing Corp.

Division Facts for 2's, 3's, 4's, M-33-34; Grades 3-4; Field Enterprises Educational Corp.

Division Facts for 5's, 6's, 7's, M-35-36; Grades 3-4; Field Enterprises Educational Corp.

Division Facts for 8's and 9's; M-37-38; Grade 4; Field Enterprises Educational Corp.

Division Terms, M-39; Grades 4-5; meaning of terms divided, divisor, and quotient, how to use division symbol. Field Enterprises Educational Corp.

Division: Two-Place Dividends, M-41-42; Grades 4-5; Five steps to working division problems; Field Enterprises Educational Corp.

Division: Using Zero, M-44; Grades 4-5; What to do when there is a zero in some part of a division problem, zero as a place holder; Field Enterprises Educational Corp.

Elementary Arithmetic-Addition I Grade 3: Counting, beginning addition, and place value; Honor Products Company (Division of Bolt, Beranek and Newman, Inc.)

Elementary Arithmetic-Multiplication and Division I; Grade 3; Honor Products Company.

Elementary Arithmetic-Multiplication and Division II; Grade 3; Honor Products Company.

Elementary Arithmetic Series; Addition and Subtraction Facts Using Numbers 1-10; Grades 1-2; Addition and subtraction of numbers, ten and less; Teaching Materials Corp.

Elementary Arithmetic Series; Decimal Numbers; Grade 4; How to add, subtract, multiply, and divide decimal numbers; Teaching Materials Corp.

Elementary Arithmetic Series: Fractions Basic Concepts; Grade 3; how to add, subtract, multiply, and divide fractions; Teaching Materials Corp.

Elementary Arithmetic Series; Multiplication & Division Facts 1 through 100; Grade 3; Basic Concepts of multiplication and division; Teaching Materials Corp.

Elementary Arithmetic-Subtraction 1; Grade 3, subtraction combinations, words and symbols of subtraction; Honor Products Company.

Equal Fractions, M-70; Grades 4-6; meaning of equal fractions and how to change fractions to higher and lower terms; Field Enterprises Educational Corp.

Estimation; Grades 4-6; Approximation and estimation methods; McGraw-Hill Book company.

Facts and Place Value System; Arithmetic, U-3008, Unit 3; Grades 2-6; number facts from 0-10, addition in simple columns, using units and tens, "carrying." Dav-Pro, Advertising Corp.

Finding an Average, M-90; Grades 4-5; how to find an average of two or more numbers through formula of add, count, and divide; Field Enterprises Educational Corp.

Fraction Terms, M-68; Grades 5-6; Names of numbers used to make a fraction, what numbers in fraction stand for; Field Enterprises Educational Corp.

Fractions; Grades 3-4; Fractions; unit and non-unit, like and unlike, improper and equivalent, mixed numbers, the number line; Grolier Educational Corp.

Fractions I; Grade 4; concept of part of any whole to part of many and equality of certain fractions; Honor Products Company.

Fractions II; Fractions, Arithmetic, Volume I; Grade 4; adding and subtracting fractions; Honor Products Company.

Fractions: Factoring, M-80; Grade 6; meaning of prime factors and factoring, how to find prime factors of a number; Field Enterprises Educational Corp.

Geometry: Areas of Circles, M-66; Grade 6; Field Enterprises Educational Corp.

Geometry: Areas of Rectangles and Squares, M-62; Grade 6; how to find number of square units enclosed by perimeter of rectangle or square; Field Enterprises Educational Corp.

Geometry: Areas of Triangles, M-64; Grade 6; Field Enterprises Educational Corp.

Improper Fractions, M-74; Grades 5-6; how to change a whole number to an improper fraction; Field Enterprise Educational Corp.

Linear Measure, M-58; Grade 3-4; how to measure inch, foot, yard, and mile; Field Enterprises Educational Corp.

Liquid Measure, M-57; Grade 3-4; how to measure ounce, pint, quart, and gallon; Field Enterprises Educational Corp.

Mathematics Enrichment Series: Program C; Grade 6; Sets, geometry, numeration; Harcourt, Brace & World, Inc.

Multiplication and Division; Grades 3-5; Basic concepts of multiplication and division, multiplication and division equations; Grolier Educational Corp.

Multiplication Facts for 1's, 2's, 3's, M-24-25; Grade 3; Field Enterprises Educational Corp.

Multiplication Facts for 4's, 5's, 6's, M-26-27; Grade 3; Field Enterprises Educational Corp.

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Regrouping in Subtraction, M-21 Grade 3; regrouping from 10's to 1's in the minuend; Field Enterprises Educational Corp.

Rounding Off Decimals, M-83-84; Grades 5-6; Rounding off decimals in 10th's, 100th's, and 1,000th's; Field Enterprises Educational Corp.

Subtraction Facts for 1's, 2's, 3's, M-14-15; Grade 3; Field Enterprises Educational Corp.

Subtraction Facts for 4's, 5's, and 6's; M-16-17; Grade 3; Field Enterprises Educational Corp.

Subtraction Facts for 7's, 8's, 9's, M-18-19; Grade 3; Field Enterprises Corp.

Three-Place Dividends in Division, M-43; Grades 4-5; Field Enterprises Educational Corp.

Using Zero in Decimals, M-32, Grades 5-6; Forming 10th's, 100th's, and 1,000th's; Field Enterprises Educational Corp.

Programmed Practice Books Available (3-6) Houghton Mifflin

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California Test Bureau, (Division of McGraw-Hill Company), Del Monte Research Part, Monterey, California 93940

Central Scientific Company, Cenco Center, 2600 South Kostner Avenue, Chicago, Illinois 60623

Coronet Instructional Films, (Division of Esquire, Incorporated), 65 East South Water Street

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Encyclopaedia Britannica Educational Corp., 425 North Michigan Avenue, Chicago, Illinois 60611

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Noble and Noble Publishers, Inc. (Subsidiary of Dell Publishing Co., Inc.), 750 Third Avenue, New York, New York 10017

Teaching Materials Corporation (Division of Grolier, Incorporated), New York, New York 10022

The Welch Scientific Company, 7300 North Linder Avenue, Skokie, Illinois 60076

Teacher's Resource Materials

The Arithmetic Teacher and *The Mathematics Teacher.* NCTM

Notes on Mathematics in Primary Schools. Cambridge University Press.

Discovery in Mathematics, and Explorations in Mathematics, by Robert B. Davis, Teachers' Editions. Addison-Wesley Publishing Co.

Mathematics in Primary Schools, Curriculum Bulletin No. 1, The Schools Council. SEE

In-Service Course #1, Madison Project. Madison Project, Grades K-9.

Beginnings, Mathematics Begins, Computation and Structure, Shape and Size, Desk Calculators, How to Build a Pond. Nuffield Foundation Mathematics Project materials. John Wiley & Sons.

I Do and I Understand. Pictorial Representations. John Wiley & Sons.

First Grade Diary. Robert Hightower and Lore Rasmussen. Xerox Education Division.

Amusements in Mathematics. Dover Publications.

Teaching Aids for Modern Mathematics. Paper. Holt, Rinehart & Winston.

Enrichment Mathematics for the Grades. Cloth. NCTM.

Number Line, Functions and Fundamental Topics, David Page. Macmillan Company.

Discovery, Wirtz, Botel, and Nunley. Encyclopaedia Britannica Educational Corp.

Geometry with a Tangram, David Fletcher and Joseph Ibbotson. SEE

Peas and Particles, Teachers' Guide. Webster Div., McGraw-Hill Book Company.

What is Mathematics? Oxford University Press.

Beginning Mathematics, Z. P. Dienes and E. W. Golding. Herder and Herder.

Part I- Learning Logic, Logical Games
Part II—Sets, Numbers and Powers
Part III—Exploration of Space and Practical Measuring

Building Up Mathematics, Z. P. Dienes. Herder and Herder.

Modern Mathematics for Young Children, Z. P. Dienes. Herder and Herder.

Elementary School Mathematics, Frances Flournoy, Center for Applied Research in Education.

Mathematics for Elementary Teachers, Ralph Crouch et. al., John Wiley and Son.

Mathematics Illustrated Dictionary, Bendick, Levin, Simon. McGraw-Hill, Inc.

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Modern Elementary Mathematics, Ward, Morgan and Hardgrove. Addison-Wesley

Modern Introduction to Basic Mathematics, Keedy, Addison-Wesley

New Directions in Mathematics, Association for Childhood Education International. Washington D. C.

The New Mathematics for Parents, Heimer and Newman, Holt, Rinehart and Winston.

Studies in Mathematics, Volume IX, *A Brief Course in Mathematics for Elementary School Teachers*. N. C. T. M.

Twenty-Fifth Yearbook, Instruction In Arithmetic. N. C. T. M.

Understanding Arithmetic, Swain and Nichols, Holt, Rinehart and Winston.

Structural Mathematics. Stern, Houghton Mifflin.

Modern School Mathematics, Workbook for Elementary Teachers, Houghton Mifflin.

Teaching Tapes

The following teaching tapes are available from Mincom Division 3M, 3M Center, St. Paul, Minnesota 55101:

Addition: Whole Numbers #1 R-3001—Grades 2-4
Addition: Whole Numbers #2 R-3002—Grades 2-4
Subtraction: Whole Numbers #1 R-3003—Grades 2-4
Subtraction: Whole Numbers #2 R-3004—Grades 2-4
Multiplication: Introduction #R-3005—Grades 3-5
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Division: One-Digit Divisor R-3007—Grades 4-6
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Sets of tapes titled Audio Reinforcement for Modern Math are available from Science Research Associates, 259 East Erie Street, Chicago, Illinois 60611. They cover addition, problem solving, subtraction, sets, numbers and numerals, multiplication, division, fractional numbers and enrichment topics.

Three sets of tapes are available from Imperial International Learning, 247 West Court Street, Kankakee, Illinois 60901. They are Imperial Math Skills Improvement Program, Primary Math Program, and Intermediate Math Program.

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