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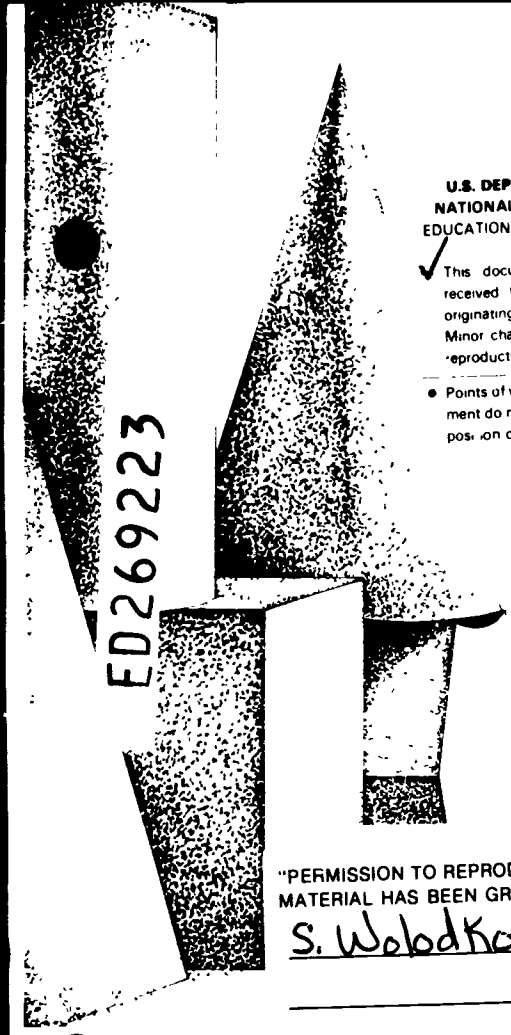
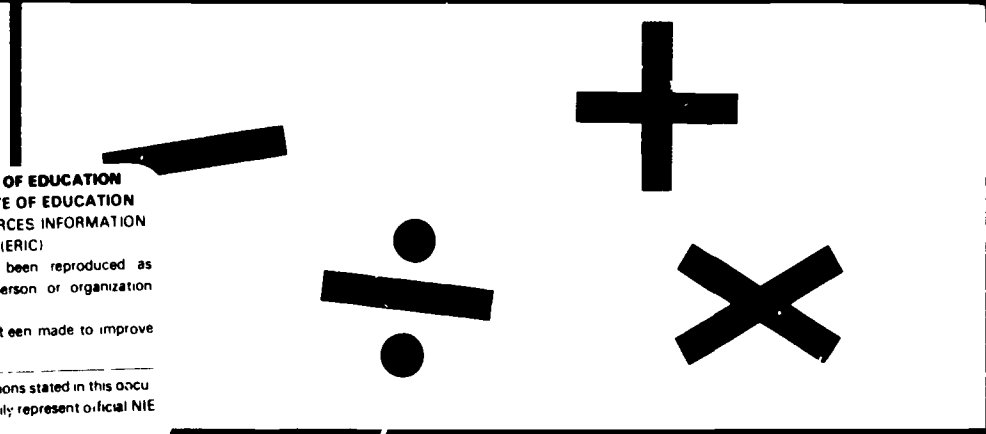
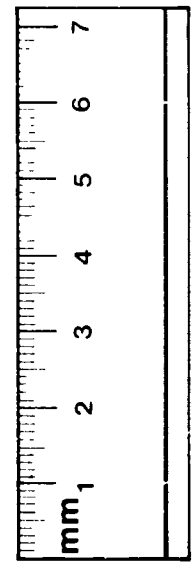
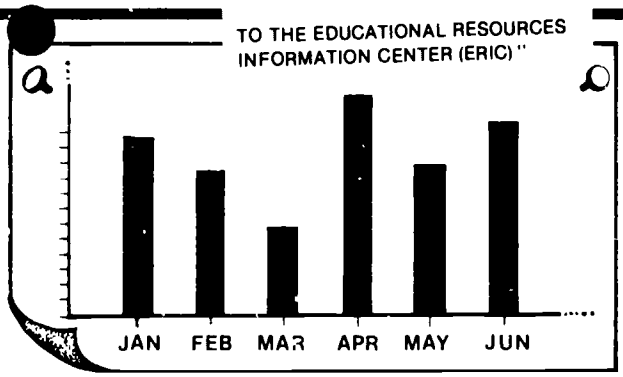
ABSTRACT

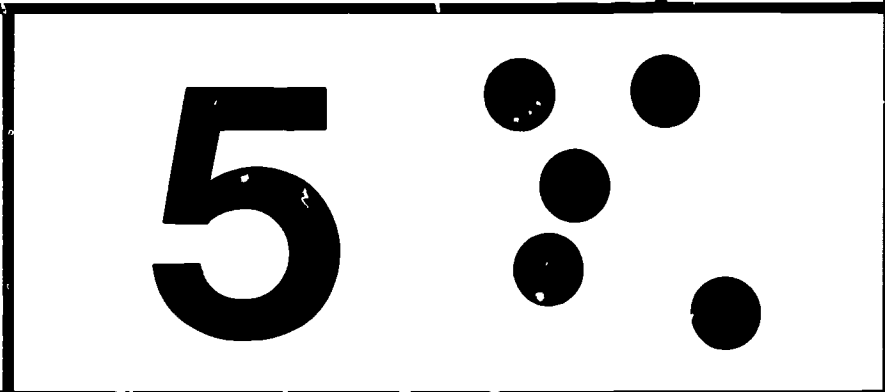
This guide opens with a brief statement on rationale and philosophy, with active learning, problem solving, and technology emphasized. Goals and objectives are stated and desirable characteristics of elementary mathematics programs are presented. The following program elements are discussed: problem-solving skills, attitudes, and mathematical concepts for five strands: numeration, operations and properties, measurement, geometry, and graphing. Program structure, allocation of time, and prescried resources are noted, the objectives, by strand, are listed for grades 1 through 6, and instructional approaches are discussed. Appendices present the National Council of Teachers of Mathematics recommendations, study notes and comments for each grade level by objective, some suggested ideas for extension and enrichment topics, and calculator guidelines. (MNS)











ELEMENTARY MATHEMATICS

CURRICULUM GUIDE 1982

Curriculum

Alberta EDUCATION

ELEMENTARY MATHEMATICS CURRICULUM GUIDE 1982

(Revised 1977 Program of Studies)

Alberta
EDUCATION

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ELEMENTARY MATHEMATICS PROGRAM REVISION COMMITTEE

Dr. Al Anderson, Consultant, Medicine Hat School District #4 (Chairman)

Mr. Rod Anderson, Supervisor, Edmonton Public School Board

Dr. Bill Bober, Supervisor, Edmonton Catholic School Board

Mr. Hank Boer, Consultant, Lethbridge School District #51

Mr. Marshall Bye, Supervisor, Calgary Board of Education

Mr. Joe Hazelzet, Supervisor, Calgary Catholic School Board

Mr. Don Nissen, Director of Elementary Education, County of Strathcona #20

Mr. Richard Pawloff, Coordinator of Instruction, Red Deer Public School District #104

Mr. Garry Popowich, Associate Director of Curriculum, Curriculum Branch, Alberta Education

Mr. Henry Taschuk, Consultant, Edmonton Public School Board

Alberta Education acknowledges with thanks the following:

Compilation and Development:	W. Blair
Learning Resource Officer:	R. McConnell
Copy Editing:	E. McCardle
Photography:	C. Evans
Artwork:	S. Chen
Typing:	R. Pizzino
	M. Pudlo
Photography Sites:	Satoo Elementary School, Edmonton
	Eastwood Elementary School, Edmonton

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INTRODUCTION

THE 1982 ELEMENTARY MATHEMATICS PROGRAM OF STUDIES IS MANDATORY, BEGINNING SEPTEMBER, 1982.

Revisions to the 1977 program of studies have been minor in nature. Mathematical skills, concepts and attitudes within the program are designed to form a minimum core program for the majority of Alberta students.

Revisions to the program reflect many of the recommendations for school mathematics made by the National Council of Teachers of Mathematics. In addition, information gathered from school systems and provincial testing have helped guide these revisions. The five content strands of Numeration, Operations and Properties, Measurement, Geometry and Graphing have been retained. Greater attention is placed on problem-solving, geometry, SI metrication, decimals and mathematical applications. Minor shifting of subject matter has been made in an effort to balance content demands throughout the grades. Recognition has also been given within the program to the influence of technological advances such as the calculator and the computer (Appendix I, An Agenda For Action).

NOTE: This publication is a service document. The advice and direction offered is suggestive except where it duplicates or paraphrases the contents of the Program of Studies. In these instances, the content is color coded in the same distinctive manner as this notice so that the reader may readily identify all presciptive statements or segments of the document.

RATIONALE AND PHILOSOPHY

The role of mathematics in our world is evident in all aspects of human endeavour. Whether used by the scientist or the grocer, the need to quantify information and to perform mathematical operations for the purposes of better understanding our world, and functioning therein, is readily obvious. From time immemorial mathematics has played, and will continue to play, an important role in the history of man's existence. For these reasons, mathematics is considered to be one of the "basics" of education.

The process of schooling, and education in general must provide for opportunities to develop and extend mathematical competencies. These competencies include understanding of number and measurement concepts, facility in computational and graphing skills, understanding of geometric relationships, and the use of effective problem-solving processes. The Alberta elementary school mathematics program is designed to meet these needs through the inclusion of basic mathematical concepts, skills and attitudes.

There is general agreement that mathematical concepts and skills have not changed significantly over the years. What has changed substantially, however, is our understanding and knowledge of how children learn mathematics.

It is now widely accepted that elementary school children learn best when actively involved in the learning process. In recognition of this premise the elementary mathematics program encourages the use of manipulatives an student constructions as an important and necessary step in forming mathematical abstractions. This precept is reflected in the psychomotor component of the program throughout the subject matter statements, all of which call upon the student to be an active participant in the learning of mathematical concepts.

Problem-solving, the ability to reason and apply mathematics in problem situations, is considered an integral part of the basic skills required for mathematical literacy. The ability to solve problems increases with importance in light of the rapidly changing demands of today's technological society. Mathematics plays an important role in developing within each student the problem-solving skills that will serve throughout life.

The influence and impact of micro-electronic technology on mathematics curriculum and instruction are only beginning to be felt. There is no doubt that computer and calculator technology will result in changes in the content of mathematics programs and the manner in which concepts are taught. The questions remaining are, what changes? how quickly? and what are the implications? In view of their potential, Alberta Education encourages teachers and schools to take full advantage of the benefits of calculators and computers.

GOALS AND OBJECTIVES

The goals of the elementary school mathematics program fall into two related categories, those dealing with the learner and those dealing with mathematical content. The program is designed to:

Provide for the development of problem-solving skills. Four steps in the problem-solving process are:

i Understanding the problem

ii Developing a plan

iii Carrying out the plan

iv Looking back (evaluation)

Provide for the development of psychomotor skills through:

i Hand-eye coordination

ii Manipulation

iii Construction of spatial figures

Provide for the development and understanding of numeration, operations and properties, measurement, geometry and graphing through:

i Mathematical literacy - receiving, understanding and using mathematical terms and symbols

ii Arithmetic skills - the ability to recall basic mathematical facts and to compute

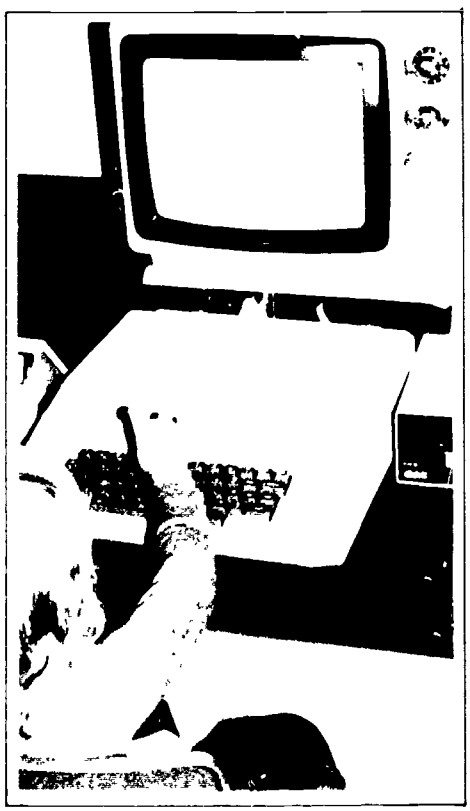
iii Application - the ability to apply appropriate methods and content to solve problems.

Foster within the learner:

i A sense of accomplishment and success

ii A positive attitude towards mathematics

iii A positive attitude towards learning.



DESIRABLE CHARACTERISTICS OF AN ELEMENTARY MATHEMATICS PROGRAM

Desirable characteristics of an elementary mathematics program are many and varied. The program should be focused on the CHILD'S WORLD. Learning through exploration and understanding of the natural environment and the man-influenced environment should be promoted. An awareness of some real-world applications of mathematics and some of the technological advances which will directly affect the child's life, should be imparted to the student. The program should be:

ACTIVITY ORIENTED	It should provide for individual student activities through physical manipulation of a variety of objects
SUCCESS ORIENTED	It should encourage the acceptance of student responses as an inquirer. It should help enhance the student's self-concept and lessen mathematical anxieties.
RELEVANT	The experience should appeal to the natural curiosity of the child about things learned both in the classroom and beyond.
[illegible]	Explorations and experiences should be provided in individual, small group and large group situations through activities which provide for extension, enrichment and remediation as is applicable.
INTEGRATED	It should be integrated with other areas of study.
INTERESTING	It should be interesting. The learning experiences should not only be educational but also stimulating in the eyes of the learner
MANAGEABLE	It should be manageable for both teacher and student. The program should allow for meaningful instructional techniques to develop concepts and skills.
PROBLEM SOLVING ORIENTED	It should promote the development of logical thinking patterns in problem solving.

The program should also

Consider the PSYCHOMOTOR, SOCIAL and INTELLECTUAL levels of the child in the provision of learning experiences and expected learning outcomes

Develop a RESPECT of and an APPRECIATION of mathematics

Promote the use of TECHNOLOGICAL ADVANCES such as the calculator and the computer.

Include a VARIETY of STUDENT'S EVALUATION approaches

PROGRAM ELEMENTS

The Elementary Mathematics Program of Studies is comprised of four main elements: problem-solving skills, psychomotor skills, attitudes, and mathematical concepts (subject matter)

A. Problem-Solving Skills

Problem-solving skills are the processes involved in collecting, organizing and interpreting information gathered from the environment. The importance of these skills lies in their utility in obtaining and applying the most useful information toward answering questions and solving problems.

In the elementary mathematics program, development of problem-solving strategies is outlined for each grade level, maintained and extended to the next grade. Facility in problem-solving requires a wide repertoire of strategies and approaches.

The teaching for understanding of problem-solving skills must also consider the intellectual growth of the child. The processes included in the program recognize the various stages of development of the child through his elementary school years.

The following chart describes four basic steps associated with the problem solving process. These steps include:

- Understanding the problem
- Developing a plan
- Carrying out the plan
- Looking back.

Within each step are problem-solving strategies which assist in the thinking through and the solving of problems. It is not intended that the total of these strategies be dealt with in the earlier grades. Teachers should consult this curriculum guide for grade by grade treatment of the problem solving component.

STEPS IN THE PROBLEM SOLVING PROCESS

UNDERSTAND THE PROBLEM	DEVELOP A PLAN	CARRY OUT THE PLAN	LOOKING BACK
STRATEGIES	STRATEGIES	STRATEGIES	STRATEGIES
1. Use Actions	1. Look for Patterns	1. Identify Objects	1. Check Groups Sorted
2. Interpret a Picture	2. Collect and Organize Data (tally and/or graphs)	2. Use Organized Data	2. Discuss Solutions
3. Identify key Words	3. Act it Out	3. Continue the Pattern	3. Check the Pattern
4. Use Manipulatives	4. Use Manipulatives	4. Use Manipulatives to Show Solutions	4. Retell the Problem with Solutions
5. Ask Questions	5. Write a Number Sentence	5. Solve Using Mathematical Symbols	5. Account for Other Possibilities
6. Restate in Your Own Words	6. Choose the Appropriate Operation	6. Perform Actions in a Problem	6. Make and Solve Similar Problems
7. Identify Wanted and Given Information.	7. Guess and Check	7. Interpret the Plan	7. Explain the Solution
8. Identify Needed Information	8. Identify Relationships	8. Identify Relationships	8. Check Solutions
9. Identify Extraneous Information	9. Sketch and Plan	9. Employ the Four Step Problem Solving Approach	9. Find Another Way to Solve it
10. Change Your Point of View	10. Set up a Mathematical Condition	10. Interpret Formulas	10. Generalize Your Solution
11. Look for Hidden Assumptions	11. Do a Simpler but Related Problem	11. Make a Flow Chart	11. Verify Formulas
	12. Use Logic or Reason	12. Make a Diagram	
	13. Collect Outside Information		
	14. Exhaust all Possibilities		
	15. Devise a Formula		
	16. Review Steps Taken		

B. Psychomotor Skills

Psychomotor skills involve coordination between the intellect and muscular movement. Development of these skills requires the handling and manipulating of a variety of materials.

Mathematical concepts are, by nature, abstract. For this reason it is necessary that children experience a variety of hands-on situations involving manipulations from which they can relate mathematical abstractions. For example, geometric relationships should be taught through manipulation and construction of geometric shapes.

The following dimensions of psychomotor skill development should be provided for within the instructional process:

- Hand-eye coordination activities
- Activities that involve the handling and use of materials and equipment
- Construction of spatial figures and solids.

C. Attitudes

Attitudes often determine what we do in given situations. Whether we persevere with something difficult or give up trying, whether we consider something worth caring about or regard it as unimportant, all relate to the attitudes we hold. The development of positive attitudes towards self and learning are primary goals of all school programs.

In the elementary mathematics program particular attention should be given to the development of:

- A positive self-concept
- A positive attitude to learning
- A positive attitude towards mathematics.

D. Mathematical Concepts (Subject Matter)

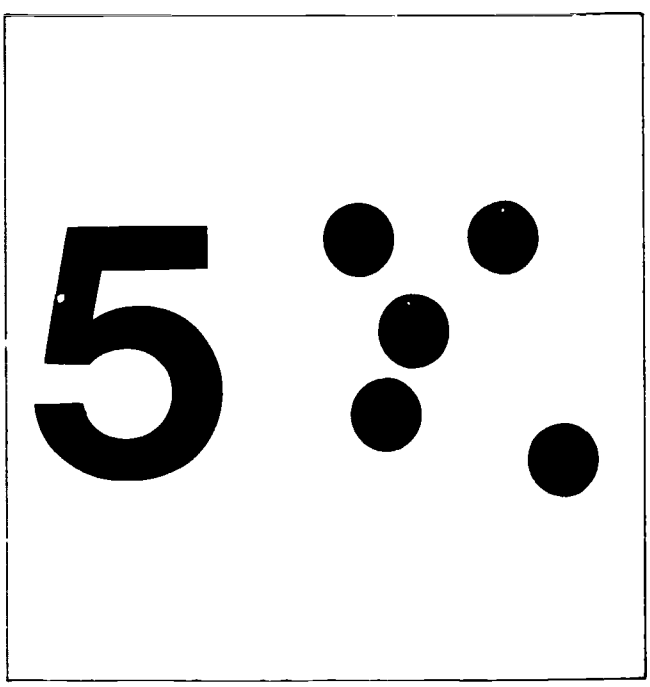
The five subject matter strands of the elementary mathematics program are: Numeration, Operations and Properties, Measurement, Geometry and Graphing. The elementary mathematics curriculum is designed to introduce concepts and skills at the most appropriate grade level, and to reinforce and extend them in later grades. The subject matter statements within each strand are not listed according to any suggested instructional order.

An integrated approach should be taken whereby concepts covered in one strand area are applied and reinforced in the other subject matter strands. The development of problem-solving skills and strategies should permeate all five strands.

1. Numeration

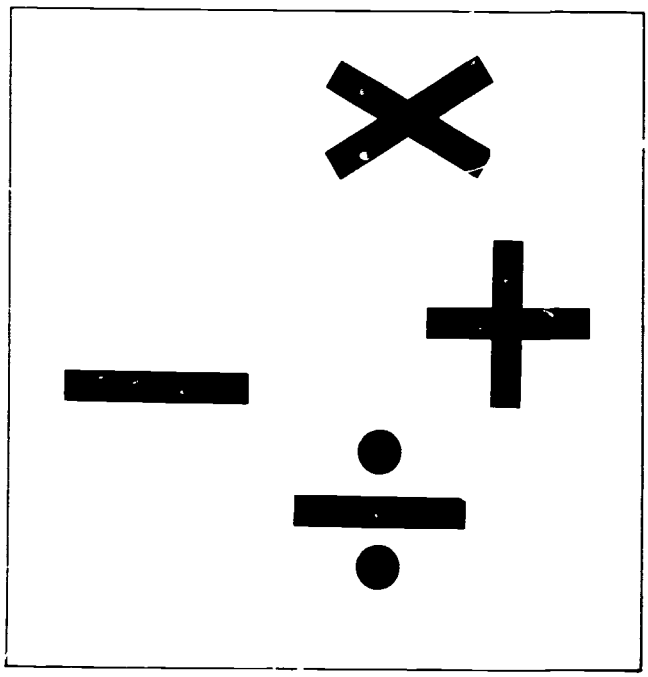
Numeration is basic to all of the other subject matter strands. This strand should first build on children's experiences with manipulatives prior to the introduction of abstract concepts.

In the numeration strand the study of fractional numbers is limited to those fractions commonly encountered and those easily converted to decimal notation (halves, quarters, thirds, fifths, tenths and hundredths). Decimal notation is introduced at the grade three level. Study of integers begins at the grade six level.



2. Operations and Properties

The operations and properties strand forms the basis for development and facility in mathematical computations. In this strand students are introduced to the concept of the four operations (+, -, x, ÷), symbolization, basic facts and then algorithmic processes.

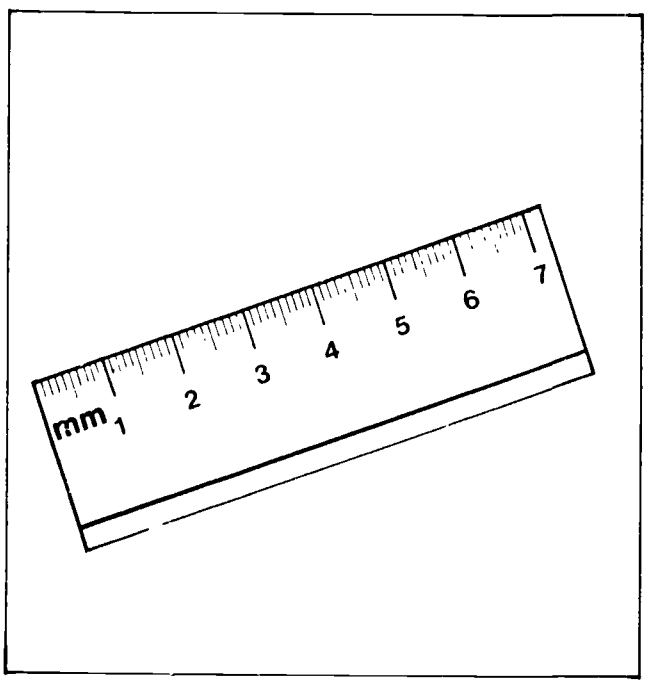


Operations with decimals begin in grade four. Computations with common fractions are NOT a part of the elementary mathematics program.

3. Measurement

The measurement strand develops the concepts of length, area, volume, capacity and mass.

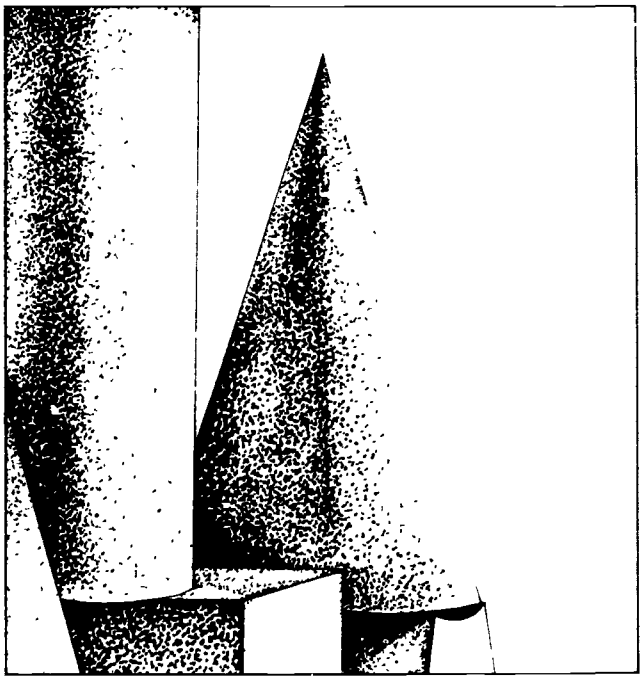
Measurement involving non-standard units is introduced in the earlier grades, with study of standard units and their symbols progressively introduced in later grade levels.



It is the policy of Alberta Education that the system International (SI) be the only system of measurement used in the schools of the province.

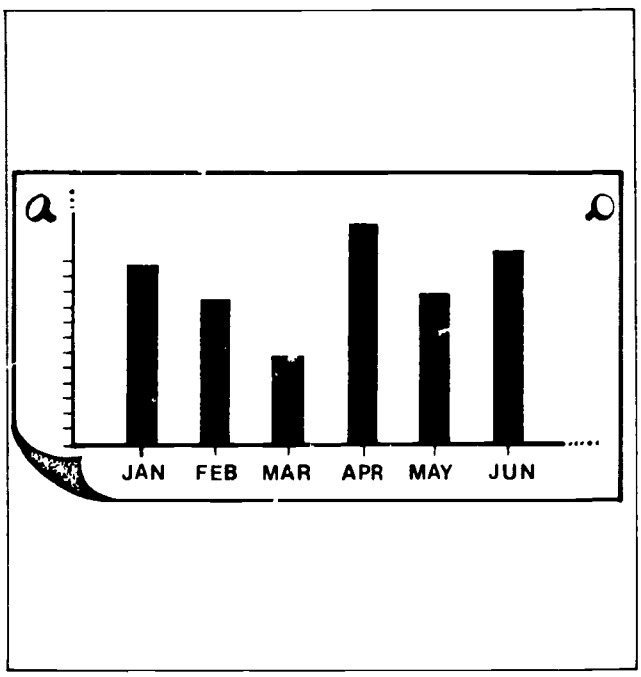
4. Geometry

Attributes of geometric shapes and spatial relationships form the basis of study in geometry. This strand builds on the child's intuitive concept of geometric forms, moving from the concrete to the formal. This is accomplished in the program by first studying three-dimensional solids through moving, sorting, classifying, constructing and describing. A similar approach is taken with two-dimensional figures. Thus motion geometry, rather than geometry based on definition, is emphasized in the elementary school program.



5. Graphing

The graphing strand is intended to develop the skills of collecting, organizing, representing and interpreting data from the student's environment. A variety of graph forms are introduced ranging from simple pictographs to the more complex circle graph in the later grades.



PROGRAM STRUCTURE

A. Minimum Core Component

The minimum core component of the program consists of mathematical concepts and skills that are designed to be achieved by the majority of students. Attitudes are developed as part and parcel of the instruction involving the skill and concept components. The method and sequence of presentation may be modified to meet the needs of individual students, ability differences within classes, and classroom organization (e.g. gifted students, remedial students, combined grades).

B. Extension/Enrichment Component

Extension/enrichment activities should be provided for those students able to go beyond the minimum core expectations. This should be in the form of horizontal development of concepts at the given grade level, applications of mathematics, or the study of mathematical topics not covered in the program (Appendix III, Some Suggested Ideas For Extension and Enrichment Topics).

C. Remediation Component

Remediation requires continual assessment of student performance. Additional time and varied instruction may be necessary to fix or reinforce a concept or skill.

ALLOCATION OF TIME

THE RECOMMENDED MINIMUM TIME PER GRADE IS 200 INSTRUCTIONAL MINUTES PER WEEK.

Additional time could be added to the mathematics program if religious studies and/or second languages are not a part of the school program.

Time should also be allowed for activity-based lessons to take place. This may require that occasionally the mathematics period will have to be extended.

The suggested weighting or emphasis to be placed on each strand is provided below. This may vary from grade to grade, or from class to class, depending on the needs of the student and class.

60% Numeration, Operations and Properties
10% Measurement
10% Geometry
10% Graphing
10 Extension/enrichment or remediation

PRESCRIBED RESOURCES

All of the prescribed resource alternatives contain more material than is required by the minimum core component. In some strand areas the prescribed resources may not cover a particular concept to the extent required by the program of studies. The program of studies rather than the prescribed resources determines the content of the elementary mathematics program. Suggestions for extension/enrichment and remediation are provided with each of the prescribed resources.

The four prescribed resource alternatives are:

1. Holt Mathematics System, Bye, M.P., et al, Holt, Rinehart and Winston, Toronto, Ontario, 1980.

2. Houghton, Mifflin Mathematics, Kelleher, H.J., et al, Houghton Mifflin Canada, Markham, Ontario, 1982.

3. Mathways, Bates, W.W., et al, Copp Clark-Pitman, Toronto, Ontario, 2nd Edition, 1980.

4. Starting Points in Mathematics, Bornhold, D.L., et al, Ginn and Company, Scarborough, Ontario, 1981.

Program of Studies

A. Problem Solving Skills

The four basic problem solving skills are:

Understanding the problem
Developing a plan
Carrying out the plan
Looking back (evaluation)

B. Psychomotor Skills

Development of those skills involving coordination between the intellect and muscular movement through direct handling a variety of materials.

C. Attitudes

Particular attention should be given to the developments of:

a positive self-concept
a positive attitude to learning
a positive attitude towards mathematics

D. Mathematical Concepts (Subject Matter)

The five subject matter strands are:

Numeration Strand
Operations and Properties Strand
Measurement Strand
Geometry Strand
Graphing Strand

SUBJECT MATTER STATEMENTS

GRADE ONE

Numeration

1. Matches members of two sets and determines equivalent and non-equivalent sets.
2. Describes number relationships; more, fewer, greater than, less than and equal to (no symbols).
3. Associates a numeral with equivalent sets (0-10).
4. Orders numbers 0-10.
5. Reads and writes numerals (0-100).
6. Identifies the number of 10's and the number of 1's in any 2-digit number.

Operations and Properties

1. Understands the process of addition and subtraction.
2. Symbolizes addition and subtraction situations.
3. Demonstrates mastery of the basic facts involving sums and minuends through 9.

Measurement

1. Tells time to the hour.
2. Recites and orders the days of the week.
3. Compares two or more objects as shorter, longer, thinner, thicker, heavier, and lighter than.
4. Estimates and measures using non-standard units of length, capacity and mass.
5. Identifies instruments for measuring length, capacity, mass, time and temperature.
6. Recognizes pennies, nickels, dimes and quarters and states the value of each.

Geometry

1. Classifies 3-dimensional objects according to various attributes.

2. Recognizes and names: circle, square, triangle and rectangle.

Graphing

1. Collects data from the immediate environment to construct graphs using pictures or objects and discusses the results.

Suggested Problem Solving Strategies

1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words.

2. Develop a Plan
   - look for patterns
   - collect data (tally and/or pictographs)
   - act it out.

3. Carry Out the Plan
   - identify objects (sorting)
   - use data (tally and/or pictographs).

4. Looking Back
   - check groups sorted
   - discuss solutions.

GRADE TWO

Numeration

1. Identifies the cardinal number associated with a set of objects.
2. Orders numbers and recognizes "betweenness" (0-100).
3. Reads and writes numerals (0-999).
4. Names and uses ordinals first to tenth.
5. Identifies the number of 100's, 10's and 1's in a given three-digit numeral.
6. Identifies multiples by counting by 5's, 10's and 100's.
7. Identifies, represents and writes proper fractions (halves, thirds and quarters) in a concrete and pictorial setting.

Operations and Properties

1. Symbolizes addition and subtraction situations.
2. Understands the basis of the commutative property for addition.
3. Understands the processes of multiplication and division.
4. Demonstrates mastery of basic facts involving sums and minuends to 18.
5. Adds and subtracts to 99 without regrouping.

Measurement

1. Tells time to the hour, half hour and quarter hour.
2. Writes the hour, half hour and quarter hour using standard notation.
3. Reads dates on the calendar.
4. Recites months of the year in order.
5. Reads the Celsius thermometer to five-degree intervals.
6. Estimates and uses standard units of length, capacity and mass with correct symbols--m, cm, L, kg.

7. Identifies appropriate measuring instruments for a given task.

8. Counts a collection of coins up to 25¢.

9. Gives equivalent value of coins up to 25¢.

10. Makes purchases up to 25¢.

Geometry

1. Classifies 3-dimensional objects in relation to corners, edges and faces.

2. Classifies 2-dimensional figures in relation to boundaries, corners and faces.

3. Develops and continues patterns using 3-dimensional objects and 2-dimensional figures.

4. Demonstrates symmetry through folding and cutting.

Graphing

1. Constructs and interprets pictographs and simple bar graphs using data collected from immediate environment.

Suggested Problem Solving Strategies

1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words
   - use manipulatives
   - ask questions.

2. Develop a Plan
   - look for patterns
   - collect data (tally and/or pictographs and bar graphs)
   - act it out
   - use manipulatives.

3. Carry Out the Plan
   - identify objects (sorting)
   - use data (tally and/or pictographs)
   - continue the pattern
   - use manipulatives.

4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - retell the problem with solution.

GRADE THREE

Numeration

1. Orders and determines "betweenness" of whole numbers (0-1 000) and understands symbols >, < and = to show relationships.

2. Reads and writes numerals (0-9 999).

3. Identifies multiples by counting by 2's, 5's, 10's, 25's, 100's (0-1 000).

4. Identifies the number of 1 000's, 100's, 10's and 1's in a number.

5. Writes numbers in expanded notation (0-1 000) and vise versa.

6. Identifies, writes and compares proper fractions from concrete and pictorial representation (halves, thirds, quarters, fifths and tenths).

7. Reads and writes decimals from concrete and pictorial situations (tenths only).

Operations and Properties

1. Identifies addition, subtraction, multiplication and division situations.

2. Adds and subtracts two or three-digit numbers with and without regrouping.

3. Symbolizes multiplication and division situations.

4. Understands the commutative property of addition and of multiplication.

5. Identifies related sentences for addition, subtraction, multiplication and division.

6. Understands the unique effect of 0 and 1 in addition and multiplication.

7. Demonstrates mastery of basic facts involving sums and minuends to 18 and products and dividends to 45.

8. Multiplies whole numbers by 10 and 100.

Measurement

1. Tells and writes the time to the nearest hour, half hour, quarter hour and five-minute intervals.

2. Orders months of the year.

3. Reads the Celsius thermometer to one degree intervals and uses the symbol (^{o}C).

4. Counts collections of coins up to $1.00.

5. Makes purchases and change up to $1.00.

6. Extends estimation and measurement to include the use of the standard units kilometre and decimetre with symbols km and dm.

7. Uses standard measuring instruments (metre stick, litre container, mass scales, calendar, Celsius thermometer).

Geometry

1. Classifies and identifies 3-dimensional objects and 2-dimensional figures.

2. Constructs simple 3-dimensional objects.

3. Constructs simple 2-dimensional figures.

4. Identifies symmetric figures and draws lines of symmetry on 2-dimensional figures.

Graphing

1. Identifies the axes.

2. Collects data, and constructs pictographs and simple bar graphs.

3. Interprets pictographs and simple bar graphs.

4. Locates position of an object on a grid.

Suggested Problem Solving Strategies

1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words
   - use manipulatives

- ask questions
- restate in your own words
- identify wanted and given.

2. Develop a Plan
   - look for patterns
   - collect data (tally and/or pictographs and bar graphs)
   - act it out
   - use manipulatives
   - write a number sentence
   - choose the appropriate operation.

3. Carry Out the Plan
   - identify objects (sorting)
   - use data (tally and/or pictographs and bar graphs)
   - continue the pattern
   - use manipulatives to show solutions
   - solve using mathematical symbols
   - perform necessary actions in a problem.

4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - retell the problem with solution
   - account for other possibilities
   - make and solve similar problems.

GRADE FOUR

Numeration

1. Rounds whole numbers (limit: to the nearest thousand).

2. Writes whole numbers in expanded notation and vice versa.

3. Identifies and names place value of digits (0.01 - 99 999).

4. Identifies, reads and writes a fraction to represent a point on a number line, a part of a region or a part of a set (emphasis on halves, thirds, quarters, fifths and tenths).

5. Identifies equivalent fractions.

6. Reads, writes and orders whole numbers and decimals (0.01 - 99 999).

7. Regroups tenths and hundredths.

Operations and Properties

1. Adds and subtracts numbers using standard and expanded notation.

2. Multiplies whole numbers by one and two-digit whole numbers.

3. Writes related sentences for addition, subtraction, multiplication and division.

4. Understands the associative property of addition and of multiplication.

5. Demonstrates mastery of basic facts for sums and minuends to 18 and products and dividends through 81.

6. Divides one and two-digit whole numbers by a one-digit divisor (with and without remainders). Estimates quotients.

7. Multiplies whole numbers by 10, 100 and 1 000.

8. Adds and subtracts decimals to hundredths.

Measurement

1. Reads and writes time to minutes.

2. Reads Celsius thermometer, and determines reasonableness of readings to given situations.

3. Extends estimation and measurement to include the use of the standard units of millimetre, millilitre and gram with symbols mm, mL and g.

4. Uses appropriate standard measuring units for length, capacity and mass.

5. Uses money (coins and bills) for purchasing and making change.

6. Expresses linear measure to nearest tenth and hundredth of a metre.

Geometry

1. Identifies properties of 3-dimensional objects and 2-dimensional figures.

2. Constructs 3-dimensionsl objects and 2-dimesnional figures.

3. Determines whether or not a 2-dimensional figure is symmetric. Draws axes of symmetry.

4. Translates (slides) and reflects (flips) concrete objects.

Graphing

1. Constructs pictographs and bar graphs.

2. Interprets pictographs and bar graphs.

3. Writes coordinates as ordered pairs.

4. Graphs ordered pairs.

Suggested Problem Solving Strategies

1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words
   - use manipulatives
   - ask questions
   - restate in your own words
   - identify wanted and given
   - identify needed information.

2. Develop a Plan
   - look for patterns
   - collect and organize data (tally and/or pictographs and bar)

- write a number sentence
- choose the appropriate operation
- guess and check
- identify relationships
- sketch and plan
- set up a mathematical condition.

3. Carry Out the Plan
   - identify objects
   - use data (tally and/or pictographs and bar)
   - continue the pattern
   - use manipulatives to show solutions
   - solve using mathematical symbols
   - perform necessary actions in a problem
   - interpret the plan
   - make a model
   - recognize the four step problem-solving approach.

4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - retell the problem with solution
   - account for other possibilities
   - explain the solution.

GRADE FIVE

Numeration

1. Identifies and names place value of digits (0.001 - 999 999).

2. Rounds whole numbers (limit: to the nearest ten thousand).

3. Rounds numbers to tenths and hundredths.

4. Expresses and generates proportional ratios.

5. Solves for the missing numeral in proportional ratios without using cross-products.

6. Expresses tenths, hundredths and thousandths as fractions or decimals.

7. Generates equivalent fractions for halves, quarters, fifths, tenths and hundredths.

8. Regroups tenths, hundredths and thousandths.

9. Reads, writes and orders whole numbers and decimals (0.001 - 999 999).

Operations and Properties

1. Adds and subtracts whole numbers. Estimates sums and differences.

2. Demonstrates mastery of basic facts.

3. Multiplies whole numbers using one, two and three-digit multipliers. Estimates products.

4. Divides whole numbers using one and two-digit divisors (with and without remainders). Estimates quotients.

5. Multiplies and divides whole numbers and decimals by 10, 100 and 1 000.

6. Adds, subtracts and multiplies decimals (sums, differences and products to thousandths).

7. Divides decimals by one-digit whole numbers.

Measurement

1. Reads and writes time to seconds.

2. Reads the 24-hour clock.

3. Extends estimations and measurements including tonne and its symbol t.

4. Reads distances according to a scale.

5. Draws 2-dimensional figures to scale using grid paper.

6. Uses appropriate standard measuring units for length, capacity and mass.

7. Understands the system of metric prefixes including use of symbols.

kilo - (k)
hecto - (h)
deca - (da)
BASIC UNIT
deci - (d)
centi - (c)
milli - (m)

8. Expresses linear measures in expanded form.

9. Expresses equivalent linear measures.

10. Finds perimeter of polygons without using formulas.

11. Finds area of polygons without using formulas.

12. Finds volume of rectangular solids without using formulas.

Geometry

1. Constructs and draws 2-dimensional figures.

2. Distinguishes 2-dimensional figures as similar, congruent or neither.

3. Identifies and draws translations (slides), reflections (flips) and rotations (turns) of 2-dimensional figures.

4. Tests congruency of polygons using translations, reflections and rotations.

5. Names corresponding sides and vertices of congruent polygons.

6. Identifies and names line segments, lines, rays and angles.

Graphing

1. Constructs pictographs, bar and line graphs.

2. Interprets and solves problems using pictographs, bar, line and circle graphs.

3. Reads and writes coordinates from a graph.

4. Graphs ordered pairs.

5. Generates ordered pairs from a given ralationship.

Suggested Problem Solving Strategies

1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words
   - use manipulatives
   - ask questions.
   - restate in your own words
   - identify wanted and given information
   - identify needed information
   - identify extraneous information
   - change your point of view.

2. Develop a Plan
   - look for patterns
   - collect and organize data (tally and/or pictographs, bar, line and circle graphs)
   - act it out
   - use manipulatives
   - write a number sentence
   - choose the appropriate operation
   - guess and check
   - identify relationships
   - sketch and plan
   - set up a mathematical condition
   - do a simpler but related problem
   - use logic or reason
   - collect outside information.

3. Carry Out the Plan
   - identify objects
   - use organized data (tally and/or pictographs bar, line and circle graphs)
   - continue the pattern
   - use manipulatives
   - solve using mathematical symbols
   - make a model

- employ the four-step problem-solving approach.

4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - retell the problem with solution
   - account for other possibilities
   - make and solve similar problems
   - explaing the solution
   - check your solutions
   - find another way to solve it.

GRADE SIX

Numeration

1. Identifies and names place value to billions (0.0001 - 1 000 000 000).
2. Writes decimal numerals using expanded notation.
3. Rounds numbers (0.0001 to 999 999 999).
4. Identifies and uses proportional ratios.
5. Expresses halves, quarters and fifths as fractions or decimals.
6. Express fractions and decimals as percents and vice versa.
7. Identifies and orders integers.
8. Reads, writes and orders whole numbers and decimals (0.0001 - 1 000 000 000).

Operations and Properties

1. Adds and subtracts whole numbers and decimals. Estimates sums and differences.
2. Demonstrates mastery of basic facts.
3. Multiplies whole numbers and decimals using one, two and three-digit multipliers. Estimates products.
4. Divides whole numbers and decimals using one, two and three-digit whole number divisors.
5. Divides whole numbers and decimals using one decimal place divisors.
6. Checks multiplication by division and division by multiplication.
7. Mentally computes simple addition, subtraction, multiplication and division.
8. Calculates averages and percentages.

Measurement

1. Finds perimeter of polygons with and without formulas.
2. Finds area of triangles and rectangles using formulas.

3. Finds volume of rectanglular solids using formulas.

4. Reads and determines distances according to a scale.

5. Draws diagrams according to a scale.

6. Reads the 24-hour clock and writes corresponding time notation

7. Understands and uses the system of metric prefixes including use of symbols: kilo, hecto, deca, BASIC UNITS, deci, centi, milli.

8. Expresses equivalent measures within units of length, capacity, mass and time with symbols.

9. Measures angles.

Geometry

1. Constructs and draws prisms, pyramids, cones and cylinders.

2. Draws and identifies radius, diameter and circumference.

3. Translates, rotates, reflects, and enlarges 2-dimensional figures.

4. Identifies and tests congruency using translations (slides), reflections (flips) and rotations (turns).

5. Names corresponding sides, vertices, angles of congruent polygons.

6. Identifies and names intersecting lines, parallel lines, perpendicular lines and angles.

Graphing

1. Constructs pictographs, bar and line graphs.

2. Interprets and solves problems using pictographs, bar, line and circle graphs.

3. Locates points in all four quadrants.

4. Generates and graphs ordered pairs from a given relationship (no negative numbers).

Suggested Problem Solving Strategies

1. Understand the Problem
   - identify key words

- use actions
- interpret a picture
- use manipulatives
- ask questions
- restate in your own words
- identity wanted and given information
- identify needed information
- identify extraneous information
- change your point of view
- look for hidden assumptions.

2. Develop a Plan
   - look for patterns
   - collect and organize data (tally and/or pictographs, bar line and circle graphs)
   - act it out
   - use manipulatives
   - write a number sentence
   - choose the appropriate operation
   - guess and check
   - identify relationships
   - sketch and plan
   - set up a mathematical condition
   - do a simpler but similar problem
   - use logic or reason
   - collect outside information
   - exhaust all possibilities
   - devise a formula
   - review steps taken

3. Carry Out the Plan
   - identify objects
   - use organized data (tally and/or pictographs, bar, line, and circle graphs)
   - use manipulatives to show solutions
   - solve using mathematical symbols
   - perform actions in problems
   - interpret the plan
   - make a model
   - employ the four-step problem-solving approach
   - interpret formulas
   - make a flow chart
   - make a diagram.

4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - retell the problem with solutions
   - account for other possibilities
   - make and solve similar problems

- explain the solution
- check your solutions
- find another way to solve it
- generalize your solution
- verify formulas

A. Instructional Approaches

Elementary school children differ widely in maturation, intellectual development and how they respond to a particular instructional approach. The teacher should be prepared to use a variety of instructional approaches to deal with these differences. The following have proven to be effective in the delivery of mathematics instruction.

1. Learning by Doing

Children display a natural curiosity about their environment and this should be used as a starting point for mathematics investigations and experiences. Children should be involved as active participants in all aspects of their learning. Since elementary school children will learn little of that which is not real to them, their everyday experiences should serve as a basis for their learning. The same holds true for mathematics.

2. Concrete to Abstract

The young student as a learner depends upon sensory information gained from direct contact and experience with real life objects and events. Since mathematical concepts are generally abstract in form, it is necessary that children be provided with experiences of a concrete nature. For example, place value concepts are abstract and difficult for most students to comprehend, yet through the manipulation of objects (e.g. Diene's Blocks) students can be guided by the teacher through a variety of experiences that result in concept formation.

Pre-number activities involving the classifying, sorting, comparing and ordering of shapes and objects also serve as a means of linking concrete reality to mathematical understanding.

3. Maintenance and Reinforcement of Concepts and Skills

Practice is necessary to fix a concept or skill once it has been introduced. Practice should follow, not precede, the discovery and understanding stages of learning, particularly in subject matter that requires memorization of procedure or facts. The practising of skills should grow out of practical activities, where the children are engaged in handling materials, measuring, discussing and recording.

B. Facilities and Materials

Organization of facilities, and the availability of manipulatives, is an important factor in the success of any mathematics program. Space should be available for students to work with a wide variety of manipulative materials. Each school should establish its own guidelines as to material storage, organization, distribution and replacement of consumables. Carts are highly desirable for the moving of equipment from one location to another. Classroom storage areas or containers facilitate ready access to material.

A display area for student work is highly recommended.

C. Evaluation Procedures and Guidelines

An effective evaluation program should serve several main purposes:

1. To indicate to students their relative success in the program.
2. To serve as a basis for determining the effectiveness of instruction.
3. To assist in planning and guiding student progress.
4. To provide information to parents and administrators.

Effective evaluation requires a variety of approaches. The use of teacher-prepared paper and pencil tests is appropriate for measuring achievement of knowledge objectives, but measurement of other content components (skills, attitudes) requires other techniques.

Evaluation techniques to assess achievement of all aspects of elementary mathematics might include some or all of the following:

1. Written survey, diagnostic, attitude, textual and teacher-made tests.
2. Formal and informal observations.
3. Anecdotal records.
4. Tests involving manipulatives or demonstrations of procedures.
5. Review of children's record books.

D. Vocabulary

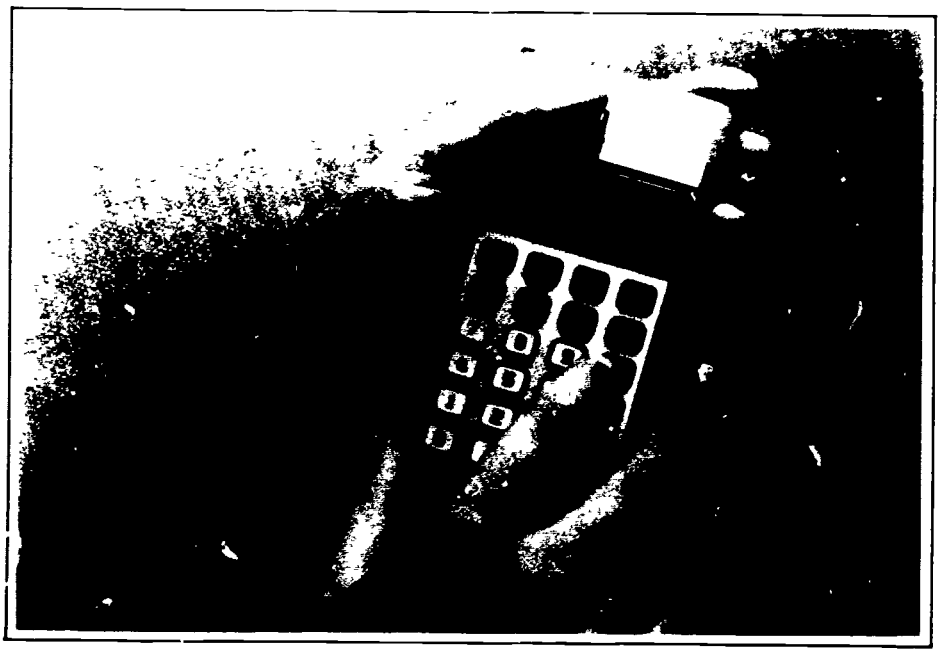
The 1982 revised program for elementary school mathematics does not emphasize the technical terminology of mathematics. For example, introduction of the terms commutative, associative and distributive, before children have formed generalizations from repeated experiences illustrating these properties, serves no useful purpose.

While the teacher and students should use a working vocabulary, it is NOT intended that the student memorize formal definitions.

E. Integration

Mathematical activity can be generated by many types of experiences in science, social studies, art, physical education, or any other discipline. Teachers should utilize opportunities to integrate subject areas in all learning situations. For example, symmetry, pattern and design can be explored through art. In studying the local neighbourhood, children can look for and record shapes in the environment. They can survey traffic flow and record their findings in graph form. They can measure distances from home to school, and construct simple maps.

It is only by drawing together these various subject areas that mathematics becomes meaningful to children. Mathematics should be explored in terms of the real problems, issues and ideas children encounter in other aspects of their life and learning.



F. Calculators

Hand-held calculators have become readily available for use in schools, hence they hold great potential as instructional and computational tools. Calculators bring new and meaningful alternatives to opportunities in the learning process. It must be strongly emphasized, however, that the calculator is not a replacement for the learning of basic mathematical facts and mental computations.

As an instructional tool, calculators can assist in the development and reinforcement of mathematics concepts and skills and motivate students to experiment with mathematical ideas. As computational tools, calculators allow more time to solve problems, thereby providing an opportunity to emphasize mathematical skills processes and applications.

Alberta Education encourages the use of calculators in Alberta classrooms. (Appendix IV, Calculator Guidelines)

G. Computers

Recent technological breakthroughs in micro-electronics have reduced the costs of computers and software to enable schools to purchase their own microcomputers. Many educators recognize the value of the computer as a powerful tool in the learning process. In mathematics its value in assisting in the development of mathematical skills and concepts is widely recognized. This is particularly true for problem-solving, drill and concept formation.

APPENDIX I
AN AGENDA FOR ACTION

The National Council of Teachers of Mathematics recommends that:

A. Problem solving be the focus of school mathematics in the 1980's;

B. Basic skills in mathematics be defined to encompass more than computational facility;

C. Mathematics programs take full advantage of the power of calculators and computers at all grade levels;

D. Stringent standards of both effectiveness and efficiency be applied to the teaching of mathematics;

E. The success of mathematics programs and student learning be evaluated by a wider range of measures than conventional testing;

F. More mathematics study be required for all students and a flexible curriculum with a greater range of options be designed to accommodate the diverse needs of the student population;

G. Mathematics teachers demand of themselves and their colleagues a high level of professionalism;

H. Public support for mathematics instruction be raised to a level commensurate with the importance of mathematical understanding to individuals and society.

REFERENCE: An agenda for Action: Recommendations for School Mathematics of the 1980's, National Council of Teachers of Mathematics, 1906 Association Drive, Reston, Virginia, 1980.

APPENDIX II
PROGRAM OF STUDIES NOTES AND COMMENTS

GRADE ONE

NUMERATION	NOTES AND COMMENTS
1. Matches members of two sets and determines equivalent and non-equivalent sets.	Use blocks, sticks, beans, to determine equivalence before using pictures. Find the set that has more. Find the set that has fewer.
2. Describes number relationships; more, fewer, greater than, less than and equal to (no symbols).	e.g. 8 is more than 4 DO NOT use 8>4. Which number is less than ___. Which number is greater than ___.
3. Associates a numeral with equivalent sets (0-10).	
4. Orders numbers 0-10.	Use next, one after, one before. Recognize order. e.g. 3, 4, __, 6, 7. Order smallest to largest and largest to smallest.
5. Reads and writes numerals (0-100).	Identify numerals given in words. e.g. three = 3 Write numerals in words. e.g. 2 = two
6. Identifies the number of 10's and the number of 1's in any 2-digit number.	Use concrete objects to group in 10's and 1's and then write the number. Then use pictorial representation. Finally: 1 ten and 7 ones = ___. ___ tens and 0 ones = 60.

OPERATIONS AND PROPERTIES	NOTES AND COMMENTS
1. Understands the process of addition and subtraction.	Begin with concrete materials by combining (addition) and separating (subtraction) groups of objects.
2. Symbolizes addition and subtraction situations.	Begin with concrete objects. Use both horizontal and vertical forms.

OPERATIONS AND PROPERTIES (continued)	NOTES AND COMMENTS
3. Demonstrates mastery of the basic facts involving sums and minuends through 9.	e.g. 6 but not 6 +3 +5

MEASUREMENT	
1. Tells time to the hour.	Include digital clock faces.
2. Recites and orders the days of the week.	The day before and/or after. The day between Monday and Wednesday. The next day.
3. Compares two or more objects as shorter, longer, thinner, thicker, heavier and lighter than.	Show order by comparing, sorting, arranging objects.
4. Estimates and measures using non-standard units of length, capacity and mass.	Use shoes, paper clips, books as units of measure to measure objects in and around school.
5. Identifies instruments for measuring length, capacity, mass, time and temperature.	
6. Recognizes pennies, nickels, dimes and quarters, and states the value of each.	

GEOMETRY	NOTES AND COMMENTS
1. Classifies 3-dimensional objects according to various attributes.	Include size, shape, colour, mass, use, texture. Discuss likenesses and differences. e.g. things that roll; things that slide Recognize faces, corners, edges.

GEOMETRY (continued)	NOTES AND COMMENTS
2. Recognizes and names: circle, square, triangle and rectangle.	Tour the school grounds and find these shapes in objects and buildings. e.g. door, window, sidewalk block.

GRAPHING

1. Collects data from the immediate environment to construct graphs using pictures or objects and discusses the results.	The ratio of real items to be graphed to bar spaces and picture representations should be one to one. Use leaves, bottle tops, stickers, beans to make graphs. Discuss the story the graph tells.

SUGGESTED PROBLEM SOLVING STRATEGIES

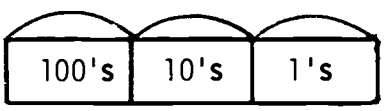
1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words.

2. Develop a Plan
   - look for patterns
   - collect data (tally and/or pictographs)
   - act it out.

3. Carry Out the Plan
   - identify objects (sorting)
   - use data (tally and/or pictographs).

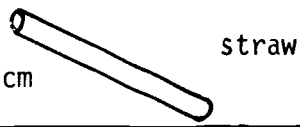
4. Looking Back
   - check groups sorted
   - discuss solutions.

GRADE TWO

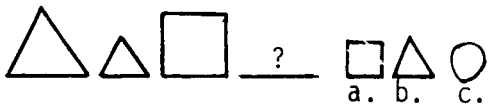
NUMERATION	NOTES AND COMMENTS
1. Identifies the cardinal number associated with a set of objects.	
2. Orders numbers and recognizes "betweenness" (0-100).	Recognize the order of numbers. e.g. 68, 69, __, 71, 72 Compare numbers without using symbols. e.g. larger, smaller Arrange numbers in order from smallest to largest and largest to smallest. Identify numbers between. e.g. which numbers come between 18 and 22
3. Reads and writes numerals (0-999)	Identify numbers given in words. e.g. three hundred fifty-six =356 Write numbers in words. e.g. eighty-two = 82
4. Names and uses ordinals first to tenth.	
5. Identifies the number of 100's, 10's and 1's in a given three-digit numeral.	Use a pocket chart and strips of paper to "make" numbers up to 999. e.g.  Then use pictorial representation. Finally: 6 hundreds, 4 tens, 3 ones = ___.
6. Identifies multiples by counting by 5's, 10's and 100's.	Count forward and backward. A calculator can be used to reinforce skip counting.
7. Identifies, represents and writes proper fractions (halves, thirds and quarters) in a concrete and pictorial setting.	Begin with concrete materials. Show on a diagram a fractional part. Given a diagram showing a fractional part, write the fraction. Use both parts of a set and parts of a whole.

OPERATIONS AND PROPERTIES	NOTES AND COMMENTS
1. Symbolizes addition and subtraction situations.	Use manipulatives before using pictures. e.g. Use both vertical and horizontal forms for addition and subtraction.
2. Understands the basis of the commutative property for addition.	A calculator can be used to reinforce the commutative property.
3. Understands the processes of multiplication and division.	Begin with concrete objects. Show that multiplication is repeated addition and that division is repeated subtraction.
4. Demonstrates mastery of basic facts involving sums and minuends to 18.	Addition to 9 + 9; subtraction to 18 - 9.
5. Adds and subtracts to 99 without regrouping.	

MEASUREMENT	
1. Tells time to the hour, half hour and quarter hour.	Use vocabulary - later than, earlier than after, quarter after, 15 min. after, half past.
2. Writes the hour, half hour and quarter hour using standard notation.	Use notation such as 2:45
3. Reads dates on the calendar.	Include year, month, day. The first day; the last day; the last Monday.
4. Recites months of the year in order.	The month before; the month after; the month between.

MEASUREMENT (continued)	NOTES AND COMMENTS
5. Reads the Celsius thermometer to five-degree intervals.	Use temperature above and below zero.
6. Estimates and uses standard units of length, capacity and mass with correct symbols--m, cm, L, kg.	In the classroom, find things longer than a metre, shorter than a metre, about a metre. Match appropriate symbol and unit of measure to specific objects. e.g. 
7. Identifies appropriate measuring instruments for a given task.	Name an object that would be measured in specific units when given the units. Name the instrument for measuring specific objects.
8. Counts a collection of coins up to 25¢.	Recognize and use penny, nickel, dime and quarter.
9. Gives equivalent value of coins up to 25¢.	Change pennies to nickel, nickels to dime, nickels and dime to quarter and vice versa.
10. Makes purchases up to 25¢.	

GEOMETRY	
1. Classifies 3-dimensional objects in relation to corners, edges and faces.	Describe likenesses and differences. Count faces, edges, corners. Include sphere, cube, cone, cylinder, pyramid. Give a description of an object, then name the object. e.g. I have six flat square faces, twelve equal edges and eight corners.
2. Classifies 2-dimensional figures in relation to boundaries, corners and faces.	e.g. Count corners, boundaries and faces.

GEOMETRY (continued)	NOTES AND COMMENTS
3. Develops and continues patterns using 3-dimentional objects and 2-dimentional figures.	e.g. 
4. Demonstrates symmetry though folding and cutting.	e.g. Cut out hearts, snowflakes by folding a piece of paper and then cutting to get a symmetrical shape.

GRAPHING

1. Constructs and interprets pictographs and simple bar graphs using data collected from immediate environment.	The ratio of real items to be graphed to bar spaces and picture representations should be one to one.

SUGGESTED PROBLEM SOLVING STRATEGIES

1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words
   - use manipulatives
   - ask questions.

2. Develop a Plan
   - look for patterns
   - collect data (tally and/or pictographs and bar graphs)
   - act it out
   - use manipulatives.

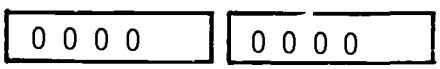
3. Carry Out the Plan
   - identify objects (sorting)
   - use data (tally and/or pictographs)
   - continue the pattern
   - use manipulatives.

PROBLEM SOLVING (continued)

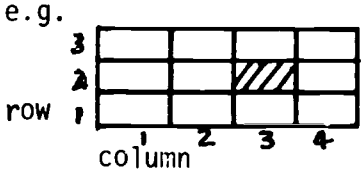
4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - retell the problem with solution.

GRADE THREE

NUMERATION	NOTES AND COMMENTS
1. Orders and determines "betweenness" of whole numbers (0 - 1 000) and understands symbols <, > and = to show relationships.	Recognize the order of numbers. e.g. 896, 897, 898 , ___, 900. Arrange numbers in order from smallest to largest and from largest to smallest. Identify numbers between - e.g. which numbers some between 38 and 40?
2. Reads and writes numerals (0-9 999).	Identify numbers given in words. e.g. eighty-five = 85 Write numbers in words. e.g. 950 = nine hundred fifty.
3. Identifies multiples by counting by 2's, 5's, 10's, 25's, 100's, (0-1 000).	Count forward and backward. e.g. 50, 40, 30, 20, 10 Count nickels, dimes and quarters to $1.00.
4. Identifies the number of 1 000's, 100's, 10's and 1's in a number.	A calculator can be used to advantage. e.g. Show 356 on calculator display. Have students make display read 386 (they must enter +30).
5. Writes numbers in expanded notation (0-1 000) and vice versa.	e.g. 8104 = 8 x 1000 + 1 x 100 + 0 x 10 + 4 x 1 and 5 x 100 + 3 x 10 + 0 x 1 = 530
6. Identifies, writes and compares proper fractions from concrete and pictorial representation (halves, thirds, quarters, fifths and tenths).	Begin with concrete materials and progress to pictorial representations. e.g. cut circles in half, squares in quarters Use real life situations. e.g. $\frac{1}{3}$ of a pie; gas gauge $\frac{3}{4}$ full; $\frac{1}{2}$ a glass Use both parts of a set and parts of a whole.
7. Reads and writes decimals from concrete and pictorial situations (tenths only).	Compare decimetres to a metre and centimetres to a decimetre. $0.10 is one tenth of a dollar.

OPERATIONS AND PROPERTIES	NOTES AND COMMENTS
1. Identifies addition, subtraction multiplication and division situations.	Use pictures to illustrate situations e.g. 
2. Adds and subtracts two or three-digit numbers with and without regrouping.	Include 3 addends with and without regrouping. e.g. 602 + 34 + 110 ; 438 + 895 + 102
3. Symbolizes multiplication and division situations.	Use both picture examples and word examples. e.g.  6 x 3  8 ÷ 4
4. Understands the commutative property of addition and of multiplication.	A calculator can be used to advantage here. e.g. Find the sum or product of 2 or 3 numbers using the commutative property.
5. Identifies related sentences for addition, subtraction, multiplication and division.	e.g. 8 + 9 = 17; 9 + 8 = 17; 17 - 9 = 8; 17 - 8 = 9; 3 x 5 = 15; 5 x 3 = 15; 15 ÷ 3 = 5; 15 ÷ 5 = 3
6. Understands the unique effect of 0 and 1 in addition and multiplication.	e.g. any number + 0 = the number 8 + 0 = 8 any number x 1 = the number 6 x 1 = 6 any number x 0 = 0 7 x 0 = 0
7. Demonstrates mastery of basic facts involving sums and minuends to 18 and products and dividends to 45.	Addition to 9 + 9; subtraction to 18 - 9. Multiplication 9 x 5 but not 8 x 6.
8. Multiplies whole numbers by 10 and 100.	Discover the pattern for multiplying by 10 and 100 (add 1 or 2 zeros to the given number)

MEASUREMENT	NOTES AND COMMENTS
1. Tells and writes the time to the nearest hour, half hour, quarter hour and five-minute intervals.	Use vocabulary - later than, earlier than, after, half past, five thirty, noon, midnight. Find the time from 3:50 to 4:15
2. Orders months of the year.	e.g. the sixth month of the year is ___ the month before and/or after the month between
3. Reads the Celsius thermomete, to one degree intervals and uses the symbol (^{o}C).	Use temperatures above and below zero. Record and graph the noon temperature each school day for 1 month.
4. Counts collections of coins up to $1.00.	
5. Makes purchases and change up to $1.00.	
6. Extends estimation and measurement to include the use of the standard units kilometre and decimetre with symbols km and dm.	Measure a decimetre and a kilometre on the playground or open space near the school (a trundle wheel is useful) and have students pace the distance. Estimate the distance of other objects or buildings from the school. Use maps where distances are given in kilometres and find the distance between cities by addition.
7. Uses standard measuring instruments, (metre stick, litre container, mass scales, calendar, Celsius thermometer).	Include appropriate units of measure

GEOMETRY	NOTES AND COMMENTS
1. Classifies and identifies 3-dimensional abjects and 2-dimensional figures.	Describe diffenence and likenesses. Count faces, edges, corners. Include cube, sphere, pyramid, cylinder and cone. Include circle, triangle, square, rectangle, pentagon, hexagon and octagon.
2. Constructs simple 3-dimensional objects.	Use modelling clay, plasticine, marshmallows and toothpicks.
3. Constructs simple 2-dimensional figures.	Include circle, triangle, square, rectangle.
4. Identifies symmetric figures and draws lines of symmetry on 2-dimensional figures.	
GRAPHING	
1. Identifies the axes.	
2. Collects data, and constructs pictographs and simple bar graphs.	Use such scales as 1:1, 2:1, 5:1, 10:1. Survey the class for favourite colour, television program, school subjects and graph the results. Emphasize the importance of labelling axes.
3. Interprets pictographs and simple bar graphs.	Discuss the story a graph tells and the necessity of having a title and properly labelled axes.
4. Locates position of an object on a grid.	The horizontal distance is given before the vertical distance. Locate spaces before points. e.g.  (column 3, row 2) (across 3, up 2) Locate places on a map or cars in a parking lot.

SUGGESTED PROBLEM SOLVING STRATEGIES

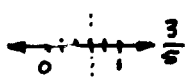
1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words
   - use manipulatives
   - ask questions
   - restate in your own words
   - identify wanted and given.

2. Develop a Plan
   - look for patterns
   - collect data (tally and/or pictographs and bar graphs)
   - act it out
   - use manipulatives
   - write a number sentence
   - choose the appropriate operation.

3. Carry Out the Plan
   - identify objects (sorting)
   - use data (tally and/or pictographs and bar graphs)
   - continue the pattern
   - use manipulatives to show solutions
   - solve using mathematical symbols
   - perform necessary actions in a problem.

4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - retell the problem with solution
   - account for other possibilities
   - make and solve similar problems.

GRADE FOUR

NUMERATION	NOTES AND COMMENTS
1. Rounds whole numbers (limit: to the nearest thousand).	e.g. 10 678 rounded to the nearest thousand = 11 000 e.g. 3 650 rounded to the nearest hundred = 3 700 e.g. 642 rounded to the nearest ten = 640
2. Writes whole numbers in expanded notation and vice versa.	e.g. $3095 = 3 \times 1000 + 0 \times 100 + 9 \times 10 + 5 \times 1$ and $8 \times 100 + 4 \times 10 + 2 \times 1 = 842$
3. Identifies and names place value of digits (0.01 - 99 999).	Identify place value. e.g. 16.24 (tenths)
4. Identifies, reads and writes a fraction to represent a point on a number line, a part of a region or a part of a set (emphasis on halves, thirds, quarters, fifths and tenths).	e.g. What is the fraction?  $\frac{3}{5}$ e.g. What fraction is shaded?  $\frac{3}{4}$ e.g. Write the fraction to show how many are shaded.  $\frac{4}{10}$
5. Identifies equivalent fractions.	e.g. $\frac{2}{3} = \frac{2 \times 2}{3 \times 2} = \frac{4}{6}$ $\frac{8}{10} = \frac{8 \div 2}{10 \div 2} = \frac{4}{5}$
6. Reads, writes and orders whole numbers and decimals (0.01 - 99 999).	Recognize the order of numbers. e.g. 0.8, 0.9, __, 1.1 Identify numbers given in words. e.g. four tenths = 0.4 Write numbers in words e.g. 0.12 = twelve hundredths.

NUMERATION (continued)	NOTES AND COMMENTS
7. Regroups tenths and hundredths.	e.g. 25 hundredths = 2 tenths + 5 hundredths. e.g. 0.25 = 0.2 + 0.05 e.g. 0.35 = 0.2 + 0.15
OPERATIONS AND PROPERTIES	
1. Adds and subtracts numbers using standard and expanded notation.	e.g. $\begin{array}{r} 1321 \\ +5639 \end{array}$ or $\begin{array}{r} 1000 + 300 + 20 + 1 \\ 5000 + 600 + 30 + 9 \end{array}$
2. Multiplies whole numbers by one and two-digit whole numbers. Estimates products.	Use rounding to estimate products as a check for reasonableness of answers.
3. Writes related sentences for addition, subtraction, multiplication and division.	e.g. 12 + 30 = 42; 30 + 12 = 42; 42 - 30 = 12; 42 - 12 = 30.
4. Understands the associative property of addition and of multiplication.	A calculator can be used to advantage here. e.g. find the sum or product of 2 or 3 numbers using the associative property.
5. Demonstrates mastery of basic facts for sums and minuends to 18 and products and dividends through 81.	Addition to 9 + 9; subtraction to 18 - 9; multiplication to 9 x 9; division to 81 ÷ 9.
6. Divides one and two-digit whole numbers by a one-digit divisor (with and without remainders). Estimates quotients.	Use rounding to estimate quotients.
7. Multiplies whole numbers by 10, 100, and 1 000.	Emphasize patterns of zeros when multiplying by 10, 100 and 1 000.
8. Adds and subtracts decimals to hundredths.	With and without regrouping. Include money.

MEASUREMENT	NOTES AND COMMENTS
1. Reads and writes time to minutes.	Include digital clock readings. Find the number of minutes from 4:12 to 4:27 Time activities using a stop watch and read time to nearest minute.
2. Reads Celsius thermometer and determines reasonableness of readings to given situations.	Knows boiling point (100°C) and freezing point (0°C) of water; cold day (-20°C), hot day (30°C).
3. Extends estimation and measurement to include the use of the standard units of millimetre, millilitre and gram with symbols mm, mL and g.	
4. Uses appropriate standard measuring units for length, capacity and mass.	e.g. distance from Edmonton to Calgary, the appropriate unit of measurement is kilometre.
5. Uses money (coins and bills) for purchasing and making change.	
6. Expresses linear measure to nearest tenth and hundredth of a metre.	Compare centimetres and decimetres to a metre.

GEOMETRY	
1. Identifies properties of 3-dimensional objects and 2 dimensional figures.	Count faces, edges, corners, sides and angles.
2. Constructs 3-dimensional objects and 2-dimensional figures.	Use pipecleaners, straws, geoboards, tinkertoys, patterns. Include cube, sphere, pyramid, cylinder and cone. Include circle, triangle, square, rectangle, quadrilateral.

GEOMETRY (continued)	NOTES AND COMMENTS
3. Determines whether or not a 2-dimensional figure is symmetric. Draws axes of symmetry.	
4. Translates (slides) and reflects (flips) concrete objects.	
GRAPHING	
1. Constructs pictographs and bar graphs.	Use such scales as 1:1, 2:1, 5:1, 10:1, 50:1, 100:1.
2. Interprets pictographs and bar graphs.	
3. Writes coordinates as ordered pairs.	
4. Graphs ordered pairs.	

SUGGESTED PROBLEM SOLVING STRATEGIES

1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words.
   - use manipulatives
   - ask questions
   - restate in your own words.
   - identify wanted and given
   - identify needed information.

2. Develop a Plan
   - look for patterns
   - collect and organize data (tally and/or pictographs and bar)
   - write a number sentence
   - choose the appropriate operation.

PROBLEM SOLVING (continued)	NOTES AND COMMENTS

- guess and check
- identify relationships
- sketch and plan
- set up a mathematical condition.

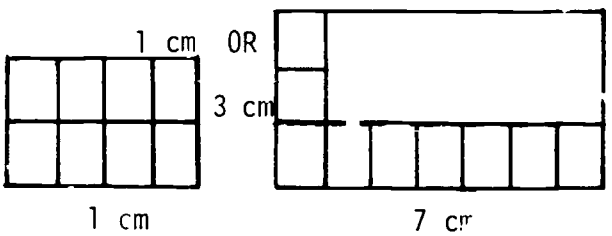
3. Carry Out the Plan
   - identify objects
   - use data (tally and/or pictographs and bar)
   - continue the pattern
   - use manipulatives to show solution
   - solve using mathematical symbols
   - perform necessary actions in a problem
   - interpret the plan
   - make a model
   - recognize the four step problem-solving approach.

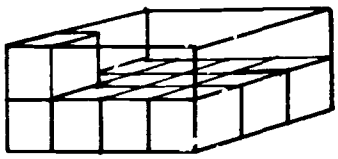
4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - recall the problem with solution
   - account for other possibilities
   - explain the solution.

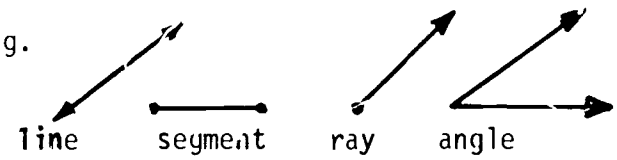
GRADE FIVE

NUMERATION	NOTES AND COMMENTS
1. Identifies and names place value of digits 0.001 - 999 999).	e.g. 24 $\underline{8}$39 (8 is in the hundreds place)
2. Rounds whole numbers (limit: to the nearest ten thousand).	e.g. 716 329 rounded to the nearest ten thousand is 720 000.
3. Rounds to tenths and hundredths.	e.g. 0.139 is rounded to 0,14.
4. Expresses and generates proportional ratios.	Interpret simple ratio situations in the form of $\frac{a}{b}$ e.g. 1 pencil costs 10¢ $\frac{1}{10}$ Generate proportional ratios by multiplying or dividing both numerator and denominator by the same value.
5. Solves for missing numeral in proportional ratios without using cross-products.	e.g. $\frac{2}{3} = \frac{6}{x}$ but $\underline{\text{not}}$ $\frac{2}{3} = \frac{5}{x}$
6. Expresses tenths, hundredths and thousandths as fractions or decimals.	
7. Generates equivalent fractions for halves, quarters, fifths, tenths and hundredths.	e.g. $\frac{1}{5} = \frac{3}{x}$ or $\frac{x}{2} = \frac{4}{8}$ but $\underline{\text{not}}$ $\frac{4}{10} = \frac{x}{15}$
8. Regroups tenths, hundredths and thousandths.	e.g. write $\frac{13}{10}$ as 1.3 Write $\frac{235}{1000}$ as 2 tenths + 3 hundredths + 5 thousandths.
9. Reads, writes and orders whole numbers and decimals (0.001 - 999 999).	Students should be able to a. recognize the order of numbers e.g. 0.06, 0.07, ___, 0.09 b. identify numbers given in words e.g. sixty-three hundredths = 0.63 c. Write numbers in words e.g. 0.5 = five tenths

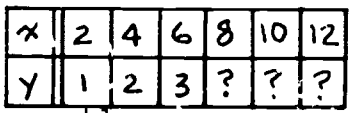
OPERATIONS AND PROPERTIES	NOTES AND COMMENTS
1. Adds and subtracts whole numbers. Estimates sums and differences.	
2. Demonstrates mastery of basic facts.	Addition to 9 + 9; subtraction to 18 - 9; multiplication to 9 x 9; division to 18 ÷ 9.
3. Multiplies whole numbers using one, two and three-digit multipliers. Estimates products	Use rounding to estimate products as a check for reasonableness of answers.
4. Divides whole numbers using one and two-digit divisors (with and without remainders). Estimates quotients.	Use rounding to estimate quotients as a check for reasonableness of answers.
5. Multiplies and divides whole numbers and decimals by 10, 100 and 1 000.	Help students discover the pattern for multiplying and dividing whole numbers by 10, 100 and 1 000 by adding or subtracting zeros. For decimals by moving the decimal point left or right the required number of places.
6. Adds, subtracts and multiplies decimals (sums, differences and products to thousandths).	
7. Divides decimals by one-digit whole numbers.	With and without ramainders.
MEASUREMENT	
1. Reads and writes time to seconds.	Include digital clocks in diagrams.
2. Reads the 24-hour clock.	Read 18:00 as eighteen hours not eighteen hundred hours. Airline, train and bus schedules use 24-hour notation.
3. Extends estimations and measurement to include tonne and its symbol t.	Estimate to the nearest tonne, the mass of given objects. Compare masses of objects to a tonne using $<, >$.

MEASUREMENT (continued)	NOTES AND COMMENTS
4. Reads distances according to a scale.	e.g. 1 cm = 1 m.
5. Draws 2-dimensional figures to scale using grid paper.	
6. Uses appropriate standard measuring units for length, capacity and mass.	
7. Understands the system of metric prefixes including use of symbols. kilo - (k) hecto - (h) deca - (da) BASIC UNIT deci - (k) centi - (c) milli - (m)	
8. Expresses linear measures in expanded form.	Students should be able to: Write linear measures in expanded form e.g. 142 cm = 1 m + 4 dm + 2 cm Write expanded linear measures in standard form. e.g. 1 m + 4 dm + 2 cm = 142 cm.
9. Expresses equivalent linear measures.	Students should be able to: Write equivalent linear measures e.g. 253 cm = 0.253 m.
10. Finds perimeter of polygons without using formulas.	
11. Finds areas of polygons without using formulas.	e.g. 

MEASUREMENT (continued)	NOTES AND COMMENTS
12. Finds volume of rectangular solids without using formulas.	e.g. 

GEOMETRY	
1. Constructs and draws 2-dimensional figures.	Use pipecleaners, geoboards, dot paper, etc. to construct polygons. Shapes studied should include circles, triangles, quadrilaterals and regular pentagons, hexagons and octagons.
2. Distinguishes 2-dimensional figures as similar or congruent or neither.	e.g. all squares have 4 equal angles (similar) even though sides may differ in length.
3. Identifies and draws translations (slides) reflections (flips) and rotations (turns) of 2-dimensional figures.	A variety of activities involving sliding, flipping and turning concrete objects followed by moving and tracing concrete objects should precede the identification and drawing of visual transformations.
4. Tests congruency of polygons using translations, reflections and rotations.	Match angles and sides of polygons by tracing.
5. Names corresponding sides and vertices of congruent polygons.	
6. Identifies and names line segments, lines, rays and angles.	e.g. 

GRAPHING	
1. Constructs pictographs, bar and line graphs.	Distinguish between the types of graphs and discuss reasons for using each type of graph.

GRAPHING (continued)	NOTES AND COMMENTS
	e.g.- pictograph - visual comparison easily interpreted, pleasing to eye - bar - usually used to compare quantity at a glance or to emphasize the extremes of various measures - line - used to illustrate continuous data rather than a comparison between different quantities.
2. Interprets and solves problems using pictographs, bar, line and circle graphs.	Emphasize the importance of proper labelling to enable people to distinguish features and interpret correctly.
3. Reads and writes coordinates from a graph.	
4. Graphs ordered pairs.	
5. Generates ordered pairs from a given relationship.	The relationship may be in the form of: e.g. an operation rule +3 (1, 4) (2, 5) (3, 6) (4, ?) (5, ?) e.g. a table of values  e.g. a problem 1 tin costs 34¢; 3 tins cost ? e.g. a completed table of values for which the rule must be found.

x	2	4	6	8	10	12
y	1	2	3	?	?	?

SUGGESTED PROBLEM SOLVING STRATEGIES

1. Understand the Problem
   - use actions
   - interpret a picture
   - identify key words
   - use manipulatives
   - ask questions
   - restate in your own words.
   - identify wanted and given information
   - identify needed information

SOLVING PROBLEMS (continued)	NOTES AND COMMENTS

- identify extraneous information
- change your point of view.

2. Develop a Plan
   - look for patterns
   - collect and organize data (tally and/or pictographs, bar, line and circle graphs)
   - act it out
   - use manipulatives
   - write a number sentence
   - choose the appropriate operation
   - guess and check
   - identify relationships
   - sketch and plan
   - set up a mathematical condition
   - do a simpler but related problem
   - use logic or reason
   - collect outside information.

3. Carry Out a Plan
   - identify objects
   - use organized data (tally and/or pictographs bar, line and circle graphs)
   - continue the pattern
   - use manipulatives
   - solve using mathematical symbols
   - perform necessary actions in a problem
   - make a model
   - employ the four-step problem solving approach.

4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - retell the problem with solution
   - account for other possibilities
   - make and solve similar problems
   - explain the solution
   - check your solutions
   - find another way to solve it.

GRADE SIX

NUMERATION	NOTES AND COMMENTS
1. Identifies and names place value to billions (0.0001 - 1 000 000 000).	
2. Writes decimal numerals using expanded notation.	e.g. $3.1295 = 3 \times 1 + 1 \times 0 + 2 \times 0.01 + 9 \times 0.001 + 5 \times 0.0001$
3. Rounds numbers (0.0001 to 999 999 999).	Write numbers as hundred millions and round to billions. e.g. 918 273 645 to the nearest billion is 1 000 000 000 Write numbers as ten thousandths and round to thousandths. e.g. 14.3175 to the nearest thousandth is 14.318 Calculator activities provide rounding practice. e.g. 5 ÷ 8 = 0.555 555 rounded to the nearest thousandth is 0.556.
4. Identifies and uses proportional ratios.	Generate proportional ratios. e.g. Apples sell for \$1.09/kg. How much for 2 kg? 5 kg? 6 kg? Solve proportional ratios without using cross products e.g. $\frac{4}{5} = \frac{x}{15}$ or $\frac{3}{x} = \frac{12}{20}$ Solve proportional ratios using cross products e.g. $\frac{3}{7} = \frac{x}{60}$ or $\frac{2.4}{7.2} = \frac{6}{x}$
5. Expresses halves, quarters and fifths as fractions or decimals.	Review writing of fractions and decimals as tenths, hundredths and thousandths. Write fractions as decimals. e.g. $\frac{3}{5} = 0.6$ Write decimals as fractions. e.g. $0.25 = \frac{25}{100} = \frac{1}{4}$ Write decimals and fractions from words. Write decimals and fractions using words.

NUMERATION (continued)	NOTES AND COMMENTS
6. Express fractions and decimals as percents and vice versa.	e.g. Fraction: $\frac{3}{10}$ Decimal: 0.3 Percent: 30%
7. Identifies and orders integers	Students may- a. identify integers on a number line b. compare and order integers e.g. -4 -1 Use integers in activities involving temperature, gains and losses (football).
8. Reads, writes and orders whole numbers and decimals (0.0001 - 1 000 000 000).	Assist students in - a. recognizing the order of numbers e.g. 1.0, 1.5, 2.0, ___, 3.0 b. identifying numbers given in words c. writing numbers using words Calculator activities can be used. e.g. Use a calculator to find the sum of the numbers. fifteen twenty-five thirty-seven
OPERATIONS AND PROPERTIES	
1. Adds and subtracts whole numbers and decimals, Estimates sums and differences.	
2. Demonstrates mastery of basic facts.	Addition to 9 + 9; subtraction to 18 - 9; multiplication to 9 x 9; division to 81 ÷ 9. Emphasize speed and accuracy.
3. Multiplies whole numbers and decimals using one, two and three-digits multipliers. Estimates products.	Use rounding to estimate products as a check for reasonableness of answers.

OPERATIONS AND PROPERTIES (continued)	NOTES AND COMMENTS
4. Divides whole numbers and decimals using one, two and three-digit whole number divisors.	With and without remainders. Use rounding skills to write decimal remainders to thousandths. Use rounding to estimate quotients as a check for reasonableness of answers.
5. Divides whole numbers and decimals using one decimal place divisors.	Review generation of equivalent fractions multiplying both numerator and denominator by 10. Use this principle to change decimal divisors to whole number divisors. Use a calculator to check answers.
6. Checks multiplication by division and division by multiplication.	Write related sentences for multiplication and division. Use a calculator to check multiplication by division and division by multiplication.
7. Mentally computes simple addition, subtraction, multiplication and division.	
8. Calculates averages and percentages.	Use the sports pages of a newspaper for real life applications.
MEASUREMENT	
1. Finds perimeter of ploygons with and without formulas.	
2. Finds area of triangles and rectangles using formulas.	
3. Finds volume of rectangular solids using formulas.	
4. Reads and determines distances according to a scale.	e.g. 1 cm = 1 m e.g. Use blueprints of house or school plans to find real distances.

MEASUREMENT (continued)	NOTES AND COMMENTS
5. Draws diagrams according to a scale.	Be an architect and design a house, a swimming pool or a building.
6. Reads the 24-hour clock and writes corresponding time notation.	e.g. 16:00 sixteen hours not sixteen hundred hours. 18:17 eighteen seventeen
7. Understands and uses the system of metric prefixes including use of symbols: kilo, hecto, deca, BASIC UNITS, deci, centi, milli.	
8. Expresses equivalent measures within units of length , capacity mass and time with symbols.	e.g. 1 dm = 10 cm 68 sec = 1 min 8 sec
9. Measures angles.	
GEOMETRY	
1. Constructs and draws prisms, pyramids, cones and cylinders.	
2. Draws and identifies radius, diameter and circumference.	
3. Translates, rotates, reflects and enlarges 2-dimensional figures.	Use geoboards or dot paper. Maps in atlases can be enlarged or comic characters can be cut out and enlarged.
4. Identifies and test congruency using translations (slides), reflections (flips) and rotations (turns).	
5. Names corresponding sides, vertices, angles of congruent polygons.	

GEOMETRY (continued)	NOTES AND COMMENTS
6. Identifies and names intersecting lines, parallel lines, perpendicular lines and angles.	Find objects in the environment that illustrate these. e.g. railway tracks, railroad crossing sign, roof gables.

GRAPHING

1. Constructs pictographs, bar and line graphs.	Use scales such as 1:1, 2:1, 5:1, 10:1, 25:1, 50:1, 100:1.
2. Interprets and solves problems using pictographs, bar, line and circle graphs.	
3. Locates points in all four quadrants.	
4. Generates and graphs ordered pairs from a given relationship (no negative numbers).	

SUGGESTED PROBLEM SOLVING STRATEGIES

1. Understand the Problem
   - identify key words
   - use actions
     interpret a picture
   - use manipulatives
   - ask questions
   - restate in your own words
   - identify wanted and given information
   - identify needed information
   - identify extraneous information
   - change your point of view
   - look for hidden assumptions.

SOLVING PROBLEMS (continued)

2. Develop a Plan
   - look for patterns
   - collect and organize data (tally and/or pictographs, bar, line and circle graphs)
   - act it out
   - use manipulatives
   - write a number sentence
   - choose the appropriate operation
   - guess and check
   - identify relationships
   - sketch and plan
   - set up a mathematical condition
   - do a simpler but similar problem
   - use logic or reason
   - collect outside information
   - exhaust all possibilities
   - devise a formula
   - review steps taken

3. Carry Out the Plan
   - identify objects
   - use organized data (tally and/or pictographs, bar, line and circle graphs)
   - use manipulatives to show solutions
   - solve using mathematical symbols
   - perform actions in problems
   - interpret the plan
   - make a model
   - employ the four-step problem-solving approach
   - interpret formulas
   - make a flow chart
   - make a diagram

4. Looking Back
   - check groups sorted
   - discuss solutions
   - check the pattern
   - retell the problem with solutions
   - account for other possibilities
   - make and solve similar problems
   - explain the solution
   - check your solutions
   - find another way to solve it
   - generalize your solution
   - verify formulas

APPENDIX III
SOME SUGGESTED IDEAS FOR EXTENSION AND ENRICHMENT TOPICS

1. Alphabet study
2. Computers
3. Constructions and designs
4. Consumer education
5. Cooking and nutrition
6. Currency study
7. Famous mathematicians
8. Field trips (e.g., business, industry, nature)
9. Finger mathematics
10. Government (e.g., taxes, debt, interest)
11. History of mathematics
12. History of measurement
13. Large numbers
14. Logic and puzzles
15. Mathematics in daily life
16. Mathematics in other subjects (e.g., music, art)
17. Networks
18. Newspaper activities (e.g., study stock market)
19. Number systems
20. Orienteering
21. Other number bases
22. Outdoor mathematics (e.g., traffic surveys, snow measures, estimating leaves, tree studies, maps)
23. Paper folding
24. Patterns
25. Permutations and combinations
26. Polyhedra constructions
27. Probability and statistics
28. Research projects
29. Scientific notation
30. Set theory
31. Short cuts and gimmicks.
32. tangrams
33. Tesselations
34. Timepieces (e.g., shadow and stick, stars, sundial, hourglass, mechanical and electronic clocks)
35. Topology
36. Vacations and mathematics

APPENDIX IV
CALCULATOR GUIDELINES

A. A Position Statement

Alberta Education encourages the use of calculators in Alberta classrooms. Their use and potential as instructional and computational aids provides new and meaningful alternatives and opportunities in the learning process. It must be strongly emphasized that the calculator is not a replacement for the learning of basic facts and mental computations.

As teaching devices calculators can contribute significantly to mathematics and mathematics-related subjects. As instructional aids, they can assist in the development and reinforcement of mathematics concepts and processes, and motivate students to experiment with mathematical ideas. While their application in mathematics is obvious, their use can be extended to other subject areas. As computational tools they reduce the time needed to solve problems, thereby allowing an opportunity to emphasize mathematical processes and applications. Through effective use calculators can improve student attitudes and motivation. It is apparent then that the calculator should not be viewed solely as an instrument to achieve rapid and accurate computations.

Other electronic devices that provide immediate feedback to students based on programmed questions and game activities are not to be confused with calculators. These devices can be used to reinforce computational skills through drill.

B. Calculators in the Classroom

1. The use of the calculator is encouraged throughout grades 1-12. When used appropriately, the calculator helps to foster exploration and experimentation, and to develop and reinforce concepts. As well, the calculator facilitates problem solving and encourages student interest in mathematics and mathematically-related subjects.

   a. Primary Level (Grades 1-3)

      The calculator should be used to extend, verify and explore mathematical ideas.

      It is recommended that one or two calculators be used occasionally at an interest centre. Seldom should the calculator be the focus for the entire class. Constructive use individually, or in a group mode supported by task cards, is encouraged.

It must be emphasized that calculators provide alternative or supplementary experiences for young children, but the continued use of manipulative material such as centimetre cubes, attribute blocks, numeration blocks, etc., for initial teaching is essential.

b. Intermediate Level (Grades 4-6)

Whenever possible the use of calculators is encouraged to support the attainment of the objectives of the curriculum.

Calculators should be used in the two following areas:

i. As an instructional tool in the development of appropriate concepts in the mathematics program.
ii. As a computational tool in problem-solving situations.

To facilitate the instructional use of calculators, it is strongly recommended that a classroom set of calculators be available at each elementary school.

2. The ease and speed with which computations can be made on a calculator should not be regarded as a substitute for learning the basic skills. The value and importance of the essential learning objectives are the primary consideration.

3. Students should be encouraged to use calculators in imaginative ways for exploring, discovering and developing mathematical concepts, but care must be taken that the calculator does not become a replacement for other well-proven strategies.

4. There will always be the need for students to possess paper-and-pencil computational skills. The use of calculators does not replace needed understanding and skills in mathematical operations and algorithms. The calculator can assist in solving problems or obtaining correct answers if the right buttons are pressed. If the student does not know which numbers to use and how to use them, the calculator will be of no use.

5. Introduction to the calculator does not presuppose that a student has mastery of the basic facts or computational skills. For example, at the elementary level students can successfully explore number patterns with a calculator without knowing the basic facts.

6. Students should be allowed time to explore the capabilities of the calculator prior to directed activities. Knowledge occurs when students are encouraged to become acquainted with a new learning device through exploration and discovery. However, they should be discouraged from using the calculator solely or primarily for checking paper-and-pencil work.

7. Calculators should be provided to students who simply cannot master the basic skills, in order to meet their arithmetic needs.

   While the vast majority of students will have no dificulties in meeting grade expectations in computational facts and procedures, a small but significant proportion of students may never master these skills. Use of the calculator may facilitate the learning of some mathematics and help to create a positive attitude towards mathematics in general.

8. At the local level, the use of calculators in district or school examinations should be governed by a policy statement that is common to all schools within the jurisdiction.

9. Prior to the introduction of the calculator in elementary schools, it is recommended that:

   a. An in-service program for teachers be implemented.

   b. Parents be informed as to the intent and procedures employed in introducing calculators into the calssroom.

NOTE: Additional information on calculator research and selection suggestions are contained in the Alberta Education publication, Guidelines for the Use of Calculators, Grades 1-12, 1981.