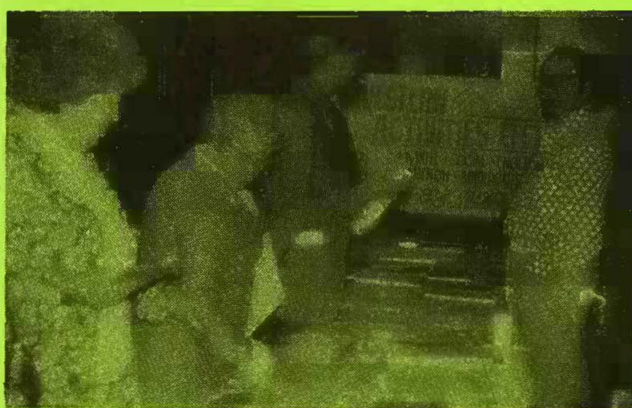
THE ALBERTA TEACHERS' ASSOCIATION MATHEMATICS COUNCIL

delta-k

Volume XVI, Number 1, September 1976

From the Editor

Annual Conference





Were you there last year -- or the year before?

This year our annual conference will be held in Red Deer. There is an article in this issue of *Delta-K* by one of the guest speakers, Frank Ebos (see p.5). Pass this issue along to your colleagues, show them your latest monograph, and encourage them to come to Red Deer with you.

IN THIS ISSUE

We Want Your Ideas!

We are interested in areas of mathematics and topics you want emphasized. Therefore, we enclose a questionnaire, which we ask you to complete and return to the Editor. This will help us in selecting articles, workshops and other activities on the use of calculators. Your cooperation in completing the questionnaire will not only aid us in planning, but will show us the need for pursuing this theme as part of our service to MCATA members. Without *your* assistance in our attempt to make this a more successful year, we will be directed by the feedback from others whose area of interest may not be yours. We are interested in *your* ideas. Write us a letter -- or an article. First consideration for space in our publications goes to Alberta authors. Second consideration is given to articles of news value. Third consideration goes to other material which is useful and timeless. An article may be published in a particular issue of *Delta-K* because that issue is devoted to a definite theme, for example the emphasis on high school contests in the May issue (newsworthy and dated item). Therefore a delay in publishing an article should not be interpreted as a rejection. It may simply mean that the Editor is using his discretion in selecting appropriate material for a particular issue. Also, changes for the purpose of good space usage without change of theme is occasionally made when necessary.

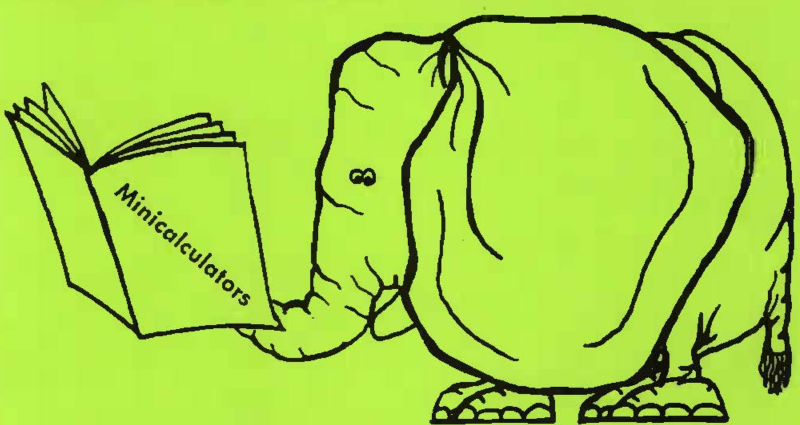
We welcome all contributions and constructive criticism that will improve *Delta-K*. Send all correspondence directly to the Editor.

Ed Carriger

CLASSROOM USE OF HAND-HELD CALCULATORS

The November 1976 issue of the *Arithmetic Teacher* will focus on instructional uses of hand-held calculators. Copies of this issue will be available for distribution at a special price of 50¢ each under the following conditions:

1. The minimum order is 100 copies.
2. All 100 copies must be sent to a single address.
3. Orders must be in the NCTM Headquarters Office by 31 August 1976.
4. NCTM will pay the shipping charges if full payment is received with the order.



To place an order, or for further information, contact Charles R. Hucka, Director of Publications Services, NCTM, 1906 Association Drive, Reston, Virginia 22091, or call 703/620-9840.

Some Ideas on Teaching a Career Mathematics Course

by R.J. Mickelson
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Teaching a career mathematics course is one of the most difficult and yet one of the most rewarding experiences in mathematics education. It has been said that a good student can learn mathematics *in spite of* the teacher, but the slow student learns only *because of* the teacher. The nonacademic student generally fits in to the latter category. I believe that even with the tremendous range of ability found in general mathematics classes, it should *not* be taught on an individual basis. These students need the motivation and guidance that an interested teacher can provide.

When the mathematics department at Queen Elizabeth implemented the new career mathematics course in September, 1974, we saw a tremendous possibility. Here was a course that related to student need and was relevant to everyday situations. Much of the career math course followed the text *(Career Mathematics, Industry and the Trades*, by Lyng *et.al.*, Houghton-Mifflin). Worksheets were provided for the better students so that the class covered the material at the same rate.

Whenever possible, related mathematics problems from the community were introduced. For example, when dealing with graphs, every student was asked to bring to class examples of graphs from magazines or newspapers. We went over each one, investigating how to improve them and pointing out how graphs can be misleading. An excellent example is shown in Figure 1.

The class was asked to comment on the reasons why the number of eggs laid and hatched were not proportional. A very interesting discussion ensued.

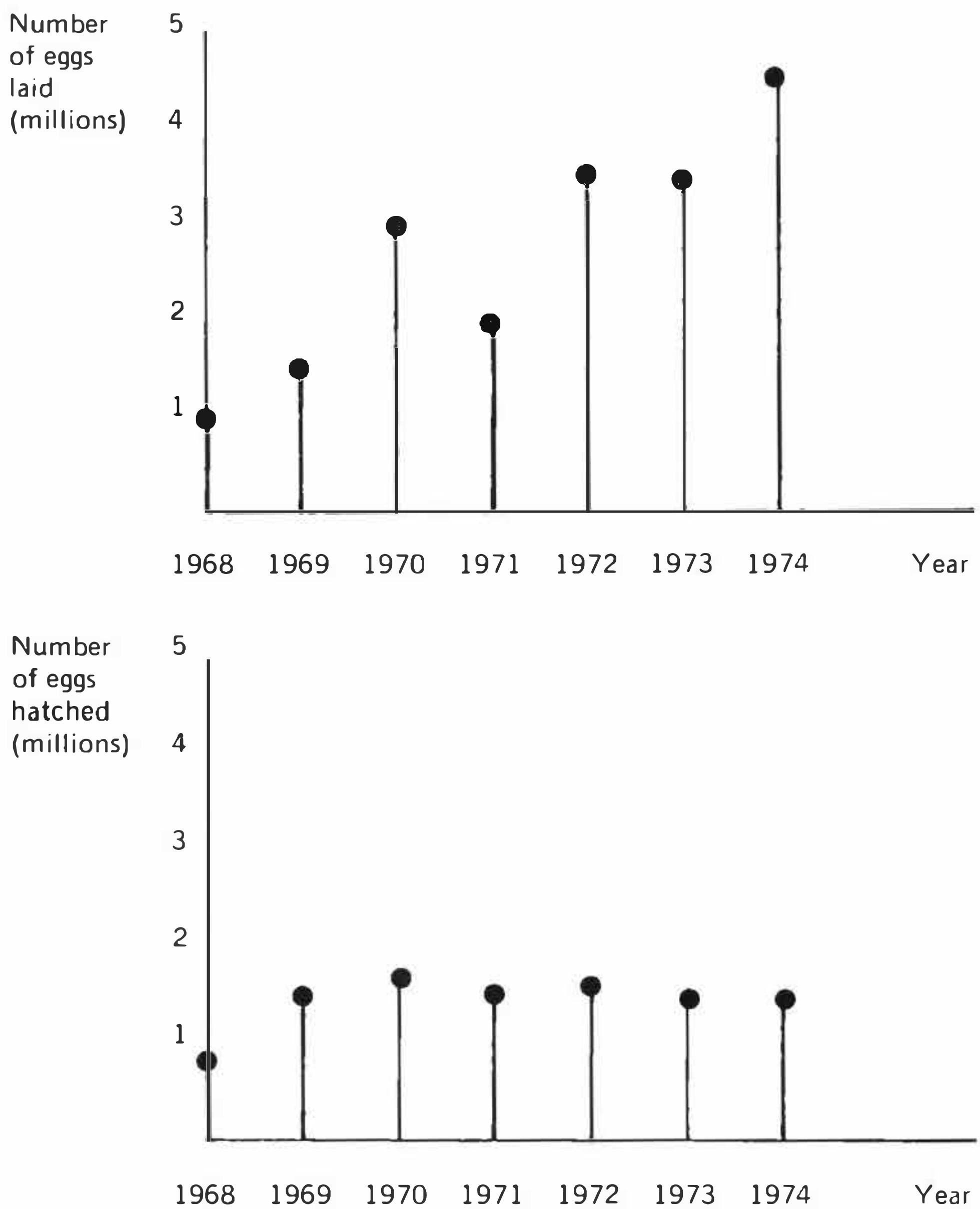
Estimating was covered quite extensively. We had a guest speaker from a lumber firm who showed how estimating is used extensively in forest management. For instance, the number of board feet of lumber per acre in a forest is estimated by taking average tree heights and diameters and average tree density or by methods involving aerial surveying. Estimating was related to the construction industry as well. We actually went out to houses under construction and estimated the amount of gyproc, shakes, insulation, and siding needed.

We also discussed examples of how computers are used in fitting the pieces needed in a pair of pants and cutting them out with a laser beam to minimize fabric waste. Container ships use the ideas of fitting the greatest number of objects into the smallest volume. In another activity, students were given a drawing of a desk of a chest of drawers together with some random lumber sizes and asked if they had enough lumber for the project if the pieces were fitted properly.

Micrometers, calipers, and resistors were actually used in the classroom. The students measured the thickness of objects such as their own hair, paper, pieces of metal, and machine bearings. Some of the students brought machine parts from the automotive and machine shops.

NICOMKEL RIVER
RESEARCH PROJECT

(Figure 1)



The concept of ratios was taught completely by example. I brought in scale models of King Kong, giant spiders, maps of the city, house plans, furniture plans, model toys, planes, and housing developments and we related these to the ratio concept.

The construction chapter was covered very thoroughly and many field trips were included. We obtained a plan for a basic 1,200 sq.ft. house and went about pricing the house in three different ways: buying the home outright, building it yourself, acting as your own contractor. This project involved obtaining estimates from construction firms, estimating the amount of material required and pricing it at local lumber yards and wholesale distributors, and contacting framing crews, electricians, plumbers, roofers, insulators, painters, etc., for prices.

We also spent time demonstrating what to look for when buying an older home. Examples were shown of dry rot in attics, houses that used cheap construction methods and materials such as return gyproc, and minimal insulation.

Since implementing this career mathematics course, as well as locally developed business and consumer math course, and a General Math 12 course, we have increased our general math enrolment from two classes to 11. This, I think, is directly related to the relevance of the material offered.

Reprinted from Vector, *British Columbia Association of Mathematics Teachers, Volume 17, Number 2, February, 1976.*

A Maze for Mathematics

by *Frank Ebos*
Faculty of Education
University of Toronto

As a classroom teacher, I often searched for a variety of ways to stimulate my students to enjoy dull drill. One particular device not only provided a way to 'drill' some basics but also provided an interesting 'twist' that reduced students' dislike to practise computational skills: This device is commonly referred to as a Maze.

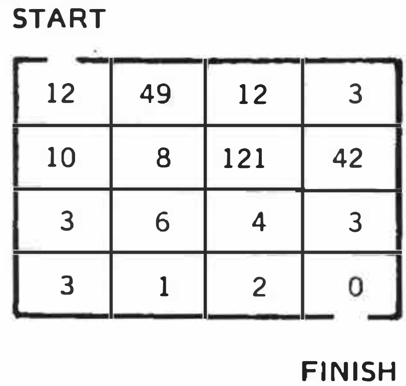
The only tools needed to make a maze are a grid of some sort to record drill questions and a supply of drill type questions. An example follows. This maze is based on straightforward calculations. Once the students find an answer, they need to study their answers to find some pattern or rule that connects START to FINISH The path followed must go horizontally or vertically (not diagonally).

START

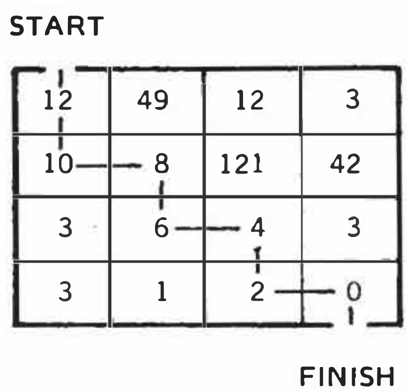
$8 \div 4 \times 6$	$49 - 7 \times 0$	$18 \div 3 \times 2$	$\frac{18-9}{9-6}$
$4 + 2 \times 3$	$16 \div 2 \div 1$	11×11	$3 \times 7 \times 2$
$\frac{8+4}{8-4}$	$24 \div (4 \times 1)$	$\frac{36}{3+6}$	$15 \div (3+2)$
$\frac{6 \times 6 - 3}{11}$	$16 \div 8 \div 2$	$\frac{8+32}{20}$	$12 \times 9 \times 4 \times 0$

FINISH

The answers for each square are shown in the next grid.



By studying their answers, the students will eventually see this simple rule or pattern: the values in consecutive boxes decrease by 2.



In finding answers, the students will eventually realize that they need not do the computation in every box.

Challenge the students to do the least number of computations to find the path (based on some pattern or rule for the answers).

There are a number of other useful mazes based on different topics. The following examples illustrate that a maze is a device that might be used to drill 'basics' in many different topics.

For each maze, a pattern or rule is given to connect START to FINISH. Keep in mind that often students will find other rules that describe the pattern they have found, other than the rules that are given.

The rule for the path in this maze is: answers are divisible by 4. This maze encourages students to do mental calculations.

START

6 X 7	16 X 3	$4^2 + 8$	64 ÷ 4
100 + 100	86 X 8	16^2	57 X 6
72 X 6 X 3	$2^2 + 3^2$	$5^2 - 4^2$	$\frac{25-16}{18}$
1000 − 864	22 X 6 X 2	$4^2 + 4^2$	$10^2 - 10$

FINISH

This maze is based on simple calculations with specific fractions. The rule for the path is: each answer is the same. Remember you cannot move on a diagonal.

FINISH

$\frac{1}{8} \times \frac{3}{4}$	$\frac{2}{3} \times \frac{4}{5}$	$\frac{3}{12} \div \frac{5}{12}$	$\frac{15}{5} \times \frac{3}{15}$
START — $\frac{3}{5} \times \frac{2}{2}$	$\frac{6}{5} \times \frac{3}{6}$	$\frac{2}{5} \times \frac{3}{5}$	$12 \times \frac{1}{20}$
$\frac{1}{4} \div \frac{1}{3}$	$\frac{11}{5} \div \frac{11}{3}$	$\frac{1}{10} \div \frac{1}{5}$	$\frac{2}{5} \div \frac{2}{3}$
$\frac{1}{3} \div \frac{3}{5}$	$\frac{5}{5} \div \frac{5}{3}$	$\frac{9}{15} \div \frac{4}{4}$	$\frac{3}{4} \times \frac{4}{5}$

The following maze is based on simple division for review. The rule for the path is: each answer has a remainder of 2.

FINISH

101 ÷ 9	86 ÷ 7	66 ÷ 8	123 ÷ 10
143 ÷ 8	55 ÷ 9	102 ÷ 10	132 ÷ 11
27 ÷ 5	32 ÷ 6	54 ÷ 13	147 ÷ 12
14 ÷ 4	46 ÷ 7	49 ÷ 6	93 ÷ 10

START

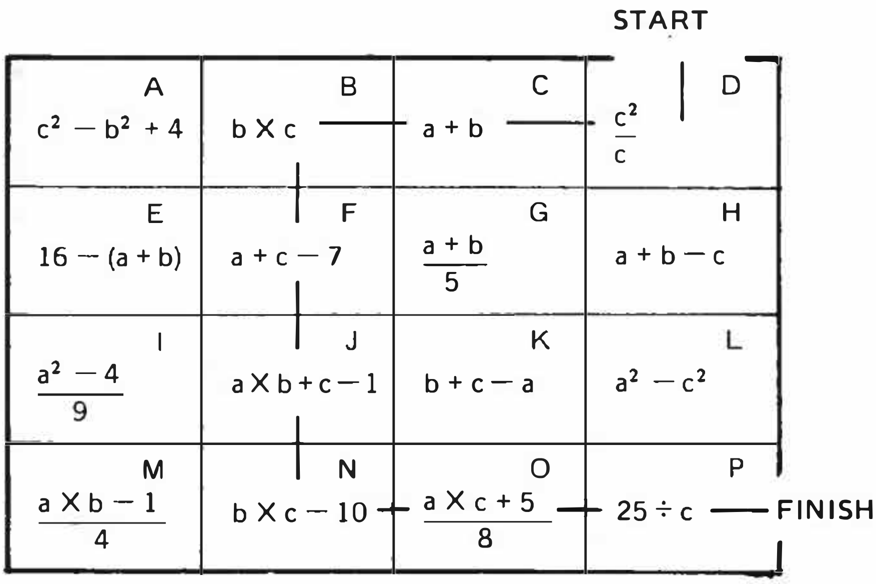
This maze is based on division. Have your students find the rule for the path.

START

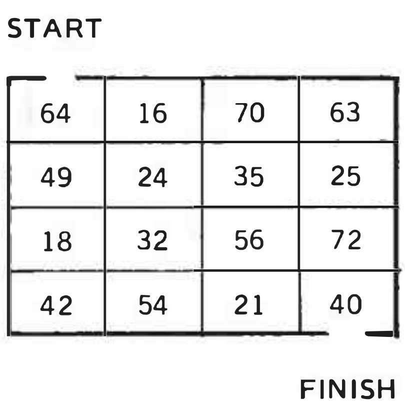
$\frac{293}{24}$	$\frac{509}{22}$	$\frac{134}{11}$	$\frac{169}{12}$
$\frac{350}{18}$	$\frac{361}{17}$	$\frac{636}{19}$	$\frac{560}{18}$
$\frac{500}{29}$	$\frac{395}{26}$	$\frac{344}{21}$	$\frac{417}{23}$
$\frac{439}{16}$	$\frac{356}{14}$	$\frac{316}{24}$	$\frac{642}{22}$

FINISH

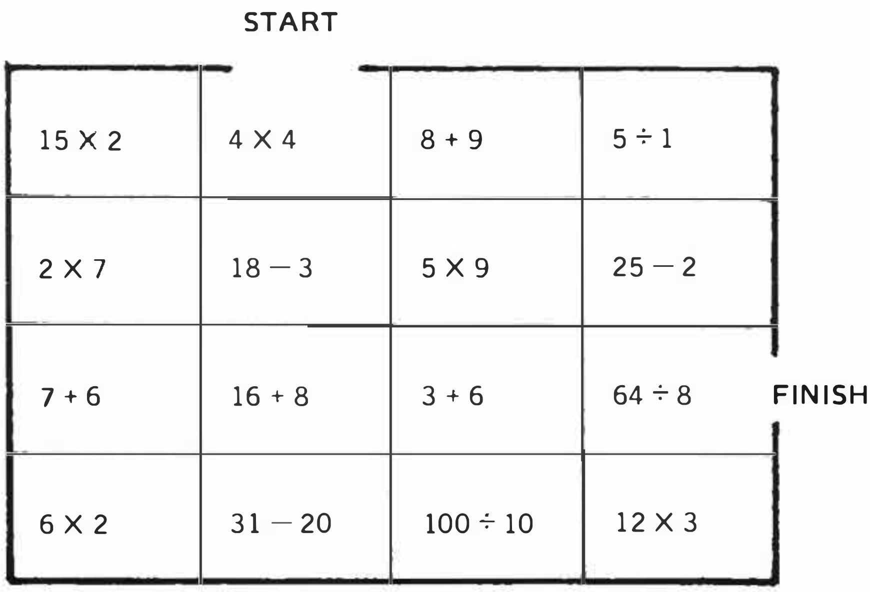
In referring to the squares in a maze it is helpful to place letters to identify them (as shown in this next maze). This maze is based on some review of substitution skills. For this maze, a = 7,b = 3,c = 5.



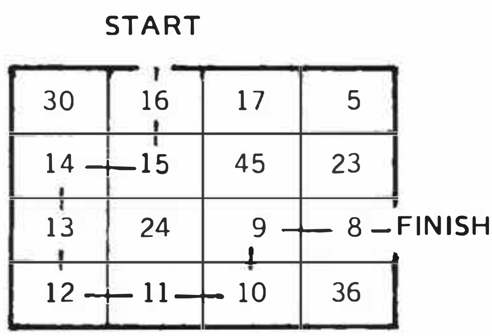
The use of mazes can be applied to different grade levels. For example, at an early grade the maze can be used to review the '8 times table' as shown. The students need to find the factors of the numbers given to find the path from START to FINISH. (The rule could be given as a the multiples of 8.)



At this level, the maze can also be used to review simple basic skills as shown on the next page.



The path is based on the rule that the answers decrease by 1 as shown.



Here is a suggestion to accumulate a number of these mazes. Have each student in the class decide on a pattern or rule for the maze to trace a path from START to FINISH.

The students then 'create' computational questions to relate to the pattern and complete the maze. They also can use their textbook as a source of questions.

Print the questions on the maze. Have the students exchange mazes and work them. In this way, any flaws will be found by the students.

If the students exchange their mazes, they can be checked for their 'work ability.'

In creating a maze the students review their basic skills for the given topic and enjoy themselves (there are exceptions!)

After this activity, you will have another source of mazes that can be drawn on later for review of the topic. Try it. They'll like it!

You will be 'amazed' how a maze stimulates interest in dull drill.

Reprinted from Vector, *British Columbia Association of Mathematics Teachers, Volume 17. Number 2, February, 1976.*

Council Adopts Position Statements

NCTM's Instructional Affairs Committee recently prepared the following statements, which have been approved by the Board of Directors.

STATEMENT ON MATHEMATICS
AND BILINGUAL/BICULTURAL EDUCATION

Every student should receive a meaningful and timely mathematics education and none should be excluded because of language or cultural differences. Schools should actively seek to identify the educational factors which diminish a student's opportunity to learn mathematics and to remove such barriers without disruption of the integrity of the student's cultural world. Special instruction in mathematics, using material in the primary language of the student, should be provided until the student can function adequately in a mathematics class conducted mainly in English or in the predominant language of the area.

GUIDANCE/COUNSELING STATEMENT
FOR BOTH COUNSELORS AND
MATHEMATICS TEACHERS AT THE
SECONDARY SCHOOL LEVEL

Today, more than ever before, the study and appreciation of mathematics are vital to the intellectual development and to the scientific, industrial, technological, and social progress of society. It is essential that teachers, counselors, supervisors, educational administrators, parents, and the general public work together to provide the best mathematics education possible for all students, regardless of sex, ethnic group, national origin, or ability. All students should be encouraged to keep options open by studying mathematics so as to make maximum use of their talents. Specifically, it is suggested that students include a maximum of mathematics appropriate to their abilities and interest in their high school programs.

The educational, vocational, personal-social choices and decisions made by students should lead to satisfying and worthwhile lives. The important members of the guidance team in each school, both the school counselor and the mathematics teacher, are responsible for helping students gain insight and understanding of themselves and their environment in this decision making. Therefore, they must work cooperatively in:

1. Planning mathematics programs for individual students.
2. Placing students in mathematics courses appropriate to their needs and abilities.
3. Anticipating developments in mathematics and fields that utilize mathematics.
4. Conferring with the school administration with regard to mathematics course offerings.
5. Planning a mathematics program designed for a specific field.
6. Securing, evaluating, and making available to students a variety of career publications.

7. Planning career-oriented activities.
8. Keeping students informed about:
    a. secondary school and college mathematics programs
    b. vocational and technical school mathematics requirements
    c. college entrance requirements in mathematics
    d. mathematics requirements for majoring in specific areas
    e. procedures for obtaining college credit for mathematics courses taken in high school
    f. career opportunities in mathematics
    g. mathematics needed for specific fields and professions

Basics in Junior High

by *Bernie Biedron*

Are basics the major emphasis in junior high school mathematics programs today? How well do your junior high students know their basics? How competent are your junior high students with their computations? These are only some of the questions which have rarely been seriously asked in the past ten years in the field of junior high mathematics. I believe it is time that we as junior high school mathematics teachers and for that matter, as mathematics teachers in general, seriously ask ourselves this question, for I believe that the basics are not the major emphasis in junior high school mathematics programs today and they definitely should be. Before proceeding any further, I will define the term basics. As far as I am concerned, basics refers to the basic elementary operations of addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals.

The opinions expressed in this article are based not only upon scientific research but also upon personal experience. I have been teaching junior high school mathematics for the past seven years and I have also taught grades five and six mathematics for a period of four years. I really became concerned and preoccupied with this idea of basics approximately three years ago when I discovered, during the early portion of the school year, that several of my grade seven students had never mastered their three times multiplication table facts. Ever since I have come to believe that, in general, junior high school mathematics students do not know their basics. Stop for one moment and think of any one particular class that you teach and see if you can honestly answer 'no' to each of the following questions. Do any of your students construct mini-multiplication tables and attach them into their mathematics notebooks in inconspicuous places? Do any of your students hesitate, for some time, when they are asked to answer very simple addition or subtraction questions? Do any of your students use fingers to facilitate computation? Now, I could go on and on, but if the answer is 'yes' to any one of these questions, then your mathematics students do not know their basics. Students should learn to become so habituated to the basic elementary operations with numbers that they do not have to think about them. I believe that teachers should do all they can to make the basic elementary operations so habitual that students do not have to think about them any more than they think when they turn on the colour television set.

What is the problem? Why don't students know their basics? Two very good questions. Ever since the '60s, when the new mathematics was first introduced everyone closely involved with mathematics and especially teachers have been overemphasizing such concepts as set theory, groups and fields, combinations, permutations, bases, etc. At the expense of the basics, and let's face it, it is much easier to teach bases than it is to teach the multiplication facts irregardless of the method employed. Secondly, I believe that the mathematical game approach has gone too far. Mathematical games are an asset to any good junior high mathematics program, but they have their place and I say let's keep them there. Dr. Max Beberman, one of the founders of the new mathematics and quite active in it for some twenty years, claims that the students of the new mathematics cannot perform the elementary operations as well as those who were subject to traditional drill. In an article in the 1971 issue of *Mathematics Teaching*, Professor Beberman repediated the entire new mathematics curriculum and was determined to pursue a totally new approach. Professor Edward G. Begle, director of the School Mathematics Study Group (SMSG) admitted that the SMSG curriculum has indeed minimized the acquisiton of the basics.

Dr. Morris Kline, professor of mathematics at New York University, claims that the new mathematics has hurt the teaching of mathematics instead of improving it mainly due to the fact that students do not have a good understanding of the basics. Closer to home, professors of pure and applied mathematics at the University of Manitoba are seriously considering the implementation of a package of basics into the first year mathematics courses. All this means only one thing to me, and that is our students do not know their basics.

What is the solution? What can be done to ensure that basics are the major emphasis in junior high school mathematics programs? Let's begin right here in Manitoba. I believe that we urgently need a master curriculum with the basics and options for each particular grade level K-12 built in, therefore comprising of one complete package. The organization of the master curriculum should involve representatives from every facet of the mathematics education field. This would include, of course, representatives from the Department of Education, universities, community colleges, high schools, junior high schools, and so on. Every school division within the province could then take the master curriculum and adapt it to suit the various needs of that particular school division continuously emphasizing the basics and implementing some of the options as necessary. This would provide for consistency in the teaching of the required basics and it would also provide for uniformity as far as students' standards are concerned. This would also mean that any one school division could virtually administer its own tests on the basic skills and thereby pinpoint the students' weaknesses. Furthermore, the province could also administer a standardized test in order to determine where the students are at as far as the basics are concerned.

I am convinced that a student cannot in any way come to possess a good understanding of the abstract concepts in mathematics -- and I mean any field in mathematics -- unless he or she has the basics at his or her fingertips.

I am also of the opinion that junior high school students should be required to learn the basics in one way or another for there is no future ahead for them if they know only one third or one half of the basics necessary in the high school program. As far as I am concerned, basics were the major emphasis of junior high mathematics, and for that matter mathematics in general, prior to the '60s when the new mathematics was introduced, and were intended to be the major emphasis according to those responsible for initiating the wave of the new mathematics, and always will be the major emphasis in mathematics regardless of the approach. Yes, basics should be the major emphasis in the junior high school mathematics program and also in any mathematics program at any level for that matter. Incidently, basics are the major emphasis at our school.

Paper presented as part of course work in 81.501, the Teaching of Secondary Mathematics, under the supervision of Professor Murray McPherson.

Reprinted from The Manitoba Mathematics Teacher, *Volume 4, Number 3, April 1976.*

This Skill of Writing Mathematically!

by *Darlene Kidd*
Macklin, Sask.

Before any of us began to write anything, we learned a set of symbols, twenty-six of them called the alphabet. Similarly before we commence to write mathematically we need the tools of the trade, another set of symbols called the numerals, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Just as all words are combinations of the letters of the alphabet so are all numbers combinations of numerals.

Soon we become interested in putting words together to express a thought and thus make a sentence. Mathematical sentences can be made too, but to express a complete thought we need more than just numerals. Other symbols that are important for the composition of number sentences are $=$,$+$, $-$, x, $\div$, $>$, $<$, $\neq$, $\ngtr$, $\nless$. Undoubtedly we could find more as there are alternate methods for expressing multiplication and division, for example, but these mentioned will suffice for our purposes.

Of course, later we are introduced to Algebra and with this introduction comes a need for a new set of symbols in order to make more complex number sentences. We usually adopt the letters of the alphabet as the necessary new symbol but in lower grades you will often notice the use of the □ and the △ and sometimes just the simple ____.

The use of our mathematical symbols usually comes quite easily to young children. Even in the first year of school a child will have no problem telling you that 5 = 5 reads "five equals five." The conversion from a number sentence to a grammatical sentence seems automatic. Similarly the student will easily read 2 + 3 = 5 as "two plus three equals five." Why then the difficulty with problems? Why then the difficulty in converting a "word" sentence to a "number" sentence?

The problem would not appear to be in the symbolism since the child has already shown his ability to recognize symbols. Instead, perhaps, we can discover the area of difficulty by examining some sample problems. Let us examine #1, P. 171 of *Modern Algebra Book 1:* The sum of two consecutive integers is 57. Find the numbers. I agree, a mess of mathematical terminology meaning nothing at first glance! We notice in the first sentence that there are some words of considerably more importance than others. "The" has little importance other than making the sentence sound complete. "Of two consecutive integers" is a prepositional phrase modifying or providing detail about "sum." "Sum" is the subject of the sentence;

it tells with what we are concerned in this sentence. "Is" is the verb and can always be represented mathematically by =. "57" is the object of the sentence and in number sentences the object always follows the =. Sometimes it helps to cross out the unimportant words and phrases. Blanking them out mentally for a moment while you find the subject, verb, and object is usually better as often the detail is useful as in our example:

subject	verb	object
sum	is	57
+	=	57

We do not have a meaningful mathematical sentence yet until we consider "of two consecutive integers." Then our expression becomes

$$x+x+1 \quad = \quad 57$$

This one-variable equation is then easily solved.

Another example from this same book is #6, P. 382: The units digit of a two-digit numeral is twice the tens digit. The sum of the digits is 12. Find the number. For each complete thought of information we have one complete number sentence. Looking back we see that "digit" is the subject, "is" the verb, and "twice the tens digit" the object of the first sentence. Before we can make a number sentence we need to know more about the subject "digit." The word "units" tells about it. Now we can write

Let u represent the units digit.
Let t represent the tens digit.

$u = 2t$.

On to the second sentence. "Sum" is the subject, "is" the verb, and "12" the object. The result: $u + t = 12$. Most students will easily solve this system of equations by the substitution method.

The problem seems to lie in the determination of what in the problem is important or, indeed, just what in a problem needs to be coded mathematically. The skill of recognizing the subject, verb, and object in a sentence seems to greatly simplify problem-solving for my students. Repeated practice and reward reinforces their efforts and encourages attempts at more difficult problems. I agree that problems appear to enjoy being complicated and even try to hide their subject, verb, and object at times. But a student with a firm background in sorting out information he needs will not flinch even when he is faced with this. (#34, P. 393, *Modern Algebra Book 1)*

If you add 1 to its denominator, a certain fraction becomes equal to 5/8. If you subtract 4 from the numerator, that fraction becomes equal to 2/5. Find the fraction.

Reprinted from News/Journal, *Saskatchewan Mathematical Teachers' Society, Volume 14, Number 2, Winter, 1976.*

Calculators Are Here to Stay

by *Gilbert Raineault*
Guyot School in
St. Boniface

The winds of change are blowing in education, sweeping away time-honored practices and replacing them with new and puzzling developments. One of these changes is still on the horizon, and its impact is still to be felt. The hand-held calculator, a novelty only two or three years ago, will soon be making inroads into the mathematics curriculum. It is now the subject of frequent articles in the daily newspapers. National news magazines and professional reviews are also following the adoption of this tool by our society and are reporting these developments to their readers.

Conditions now exist that seem to virtually assure the introduction of the calculator in the schools. First of all, the price of these machines is coming down because of mass production. Only three or four years ago, the price of a basic model was about two hundred dollars; similar models now retail for thirty or forty dollars. Some models are available for approximately twenty dollars, and rumors have it that ten-dollar units will be on the market in two or three years. Calculators will be no more expensive than good dictionaries, thus bringing them into almost universal distribution. The use of calculators is also becoming widespread in industry, and more importantly for students, in the home.

What implication does this have upon the teaching of mathematics at the junior and senior high levels? Many teachers are justifiably concerned with the prospect of seeing their students using calculators at school. They fear that the computational skills acquired at the elementary level will be forgotten, and that the students will develop a dependency on these machines, and will gradually be unable to function in mathematics without them. Indeed, putting calculators into the hands of students who have an incomplete mastery of the fundamentals of arithmetic would bring on disastrous consequences.

In spite of these reservations, the use of these machines by students will become fairly commonplace in a very short period of time. Their widespread use outside the school will almost necessitate their being accepted in the classroom. Their advent will necessitate certain changes in the mathematics curriculum. There will have to be some shift of emphasis in both subject matter and skill development to accommodate calculators. These changes will probably involve the following areas:

(1) Computational skills will still be taught, as these are absolutely essential. There will be less need, however, for the tedium of repetitious drill. Less emphasis will be placed on algorithmic computation.

(2) The basic facts of arithmetic, such as the multiplication tables, will still have to be known in order to permit the students to be able to estimate the results of the calculations done with the calculator.

(3) The students will have to master thoroughly the skills of rounding off and of finding significant digits. They will also have to know how to use these rounded figures in their calculations.

(4) A firm grasp of the concept of place value will be essential if students are to understand and make sense of the answers they will obtain from a calculator.

(5) Fractions will have a somewhat decreased importance in the curriculum, as these will be changed into their decimal equivalents for use in the calculator. Decimal numerals will also be more in use with the gradual introduction of the metric system.

(6) Teachers can anticipate some changes in the textbooks as authors and publishers will soon be taking into consideration the impact that calculators are having on the teaching of mathematics. It is to be hoped that they will get away from the artificial or "made-up" problems all too prevalent in textbooks today, where all divisions come out even and where all fractions cancel out nicely.

(7) Creative teachers will soon see the opportunity for students to solve mathematics problems using calculators in subject areas other than mathematics, thus enriching the entire curriculum. The use of calculators will permit this without loading down the students with the drudgery of endless calculations.

The introduction of calculators in the classroom will not constitute a "revolution" in mathematics education. The novelty will soon wear off, and students will soon see it as just another learning tool, much like the cassette recorder or the typewriter. However, they will have at their disposal a machine that will permit them to perform complex calculations at a great speed and with a minimum of inaccuracies. The students will soon become aware of these benefits.

The calculator will never be a panacea for all of the ills of mathematics education. Indeed, it could only add to those ills if it is used unwisely. To begin with, it has no place at the elementary school level, where students should be acquiring a solid background in the basic mathematics skills. Also, it should never be placed in the hands of a student who doesn't have a firm grip of the basic concepts and processes of mathematics. This would be detrimental to learning. However, it will liberate good students from the tedium of repetitious computations and will permit them to focus on the real importance of problem solving.

Rightly or wrongly, change in education often occurs very slowly and schools find themselves all too often behind the times. The acceptance by teachers of such a commonplace article as the ballpoint pen is a case in point. They permitted its use in schools only after it had overwhelmingly replaced the fountain pen and the quill in our society. Similarly, the calculator is not a passing fad; it is here to stay. Its use will very soon be widespread in all sectors of society. It will soon find its way in schools. Teachers will have to cope with this new development.

Provincial departments of education will have to come to the aid of these teachers. Research will have to be done to determine the impact of calculators on the mathematics curriculum. Recommendations concerning the implementation, the use, and the evaluation of the use of calculators will have to be formulated. The precautions to take while using calculators will have to be clearly stated. Teacher education programs will have to be organized. It is to be hoped that this will be available to teachers when the need is felt.

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Who Gives a Gram About Scruples?

by *Dr. Forrest L. Coltharp*
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The following article by Dr. Forrest Coltharp illustrates a problem that has been effectively solved in much of Canada. However, some of us are still in need of defending the metric conversion in our communities where resistance is continuing despite government directives requiring the change. This study may give you new ideas for overcoming resistance, or it may provide interesting reading. In any case, I include it as an item that has value to each reader within the limits of his imaginative application of the ideas and reasonings presented.

What does the United States of America have in common with the following countries?

Barbados	Oman
Burma	Nauru
Gambia	Sierra Leone
Ghana	South Yemen
Jamaica	Tonga
Liberia	Trinidad
Muscat	

You will find that all other countries in the world, except those listed above and the United States, have already adopted the Metric System of weights and measures, or have committed themselves to a change in the near future. Japan converted to the Metric System between 1951 and 1962. Great Britain adopted a ten year plan of implementation in 1965. South Africa will complete her switch to the Metric System during 1975. New Zealand began an eight year plan of conversion in 1969, and both Australia and Canada announced commitments to change in 1970.

Is it any wonder that if we are to compete in the world trade market, we must convert to the Metric System of weights and measures? Many of our multinational corporations are already in the process of converting, such as IBM, General

Motors, Boeing, RCA, Ford, John Deere and International Harvester. Suppliers to General Motors, as an example, will eventually switch their products to Metric Standards or suffer the loss of business. When one of the nation's largest manufacturers initiates a formal program to convert its products to the Metric System, it is bound to push the entire country toward a metrication program.

You might ask "How does this affect you as an individual?" Both directly and indirectly. Have you read the side panel of your favorite cereal box lately? Did you notice the contents of your canned goods are being measured in cubic centimeters or grams? Have you encountered metric measurements in patterns supplied by Simplicity or McCalls? What will you do when a great-sounding recipe involves metric measures? Ford's Mustang II is powered by 2.3-liter engine being built in the country's first all-metric engine plant. Do you have a set of metric wrenches ready to handle home repairs?

We know that most adults feel more comfortable with the familiar English system of weights and measures. You know that twelve inches make a foot and three feet make a yard; there are two cups in a pint, two pints in a quart and four quarts in a gallon. You may even know how many ounces there are in a pound, but do you know how many rods in a furlong? Do you know how many cubic inches in a quart? How many scruples in an ounce? What is a pennyweight? What is the difference between a liquid quart and a dry quart?

If you are able to answer all of these questions, then you are to be congratulated. If you cannot, you should not feel bad because most people are not familiar with all of these terms. Even measurements you feel you do know might be questionable. Did you know that in our English system of weights and measures, we have two kinds of pounds, two types of miles, two types of quarts, eight kinds of tons, and fifty-six different sizes of bushels? With this background information about our English system of weights and measures, you can obviously see that what we have to work with leaves much to be desired.

Perhaps you are wondering what is meant by *A* Metric System? It is simply a system in which the basic units are in a "tens" relationship to each other. Our monitary or coinage system is in a decimal or "tens" relationship, that is: 10 pennies equal one dime and 10 dimes equal one dollar. Our English system of weights and measures is certainly not in a tens relationship since 10 inches is not equal to one foot and 10 feet does not equal one yard. The advantage of such a system based on a tens relationship in one word would be SIMPLICITY.

What then is *THE* Metric System that we have been promoting? According to the Metric Association, Inc., "The Metric System simply and logically coordinates the measurements of length, area, volume, and mass (or weights) into one DECIMALIZED system." Hence, there are basically three principles that a system of weights and measures should include:

(1) A standard unit of measure (length, volume, or mass) based on some unchanging absolute standard which is highly reproducible,

(2) the basic units of length, volume, and mass should be interrelated and,

(3) the system should be based on a decimal system.

Our English system has only the first principle, while the Metric System has all three.

The standard units of the English system of weights and measures have some very strange origins historically. For example, the inch was defined as three grains of barley corn laid side by side. King Charlemagne decreed that a foot would be the length of his royal foot, while some other king established the yard as the distance from his nose to the end of his outstretched arm. Other units have even stranger origins.

The basic standard unit in the Metric System is the meter which is used to measure length. The meter was defined originally by a group of scientists belonging to the French Academy of Science at about the time of the French Revolution. A meter was defined at that time as 1/10,000,000 of the distance from the north pole to the equator along the meridian which ran through Paris, France. The meter was more precisely defined later as 1,650,763.73 wavelengths of the orange-red light from the isotope krypton-86. Neither of these methods of establishing the standard unit for the Metric System seems reproducible in your kitchen, home workshop, or classroom laboratory. However, by using a scientific instrument known as an interforometer, which is used to measure length by means of light waves, the meter is highly reproducible in laboratories throughout the world. Hence, principle number one is satisfied by both the English and the Metric System of weights and measures.

The second principle of a desired system of weights and measures is the interrelation between the basic units of length, volume and mass (or weight). This principle is possessed by the Metric System, but not the English system. There are two simple facts; one that relates dry volume to liquid volume and one that relates volume to weight.

In determining the volume of a box you would multiply length times width times height and the volume would be in terms of cubic measure according to the dimensions of the box. If you wanted to fill the box with liquid, the volume would be measured in liters. The fact that interrelates length and volume is: "one cubic decimeter (or 1000 cubic centimeters) of liquid is defined as one liter." If you then wanted to find the weight of the box filled with liquid, the weight would be measured in grams. The fact that interrelates volume and weight is: "one liter of water at its maximum density weighs one kilogram" or "one milliliter of water at 39.2°F (or 4°C) at sea level weighs one gram."

There are 10 summarizing facts that you should know in order to understand and appreciate the Metric System. They are:

(1) The *meter* is the basic unit of length (a little longer than a yard).

(2) The *liter* is the basic unit of volume (a little more than a quart).

(3) The *gram* is the basic unit of mass or weight (about the weight of a paper clip).

(4) *Deci* means tenths (decimeter is a tenth of a meter).

(5) *Centi* means hundredths (centiliter is a hundredth of a liter).

(6) *Milli* means thousandths (milligram is a thousandth of a gram).

(7) *Deca* means ten times (decaliter is 10 liters).

(8) *Hecto* means hundreds (hectometer is 100 meters).

(9) *Kilo* means thousands (kilogram is 1000 grams).

(10) Ability to multiply and divide by ten and powers of ten.

The use of prefixes on the basic units (meter, liter, and gram) denotes powers of ten and satisfies the third principle of a desired system of weight and measures (i.e., it should be based on a decimal system). The prefixes are used on each of the three basic units, but I shall use meter as an example of what they mean. A decimeter is 1/10 of a meter or .1 meter. Another way to indicate this is to say 10 decimeters equal 1 meter. A centimeter equals 1/100 of a meter, or .01 meter, or 100 centimeters equal 1 meter. A millimeter is 1/1000 of a meter, or .001 meter, or 1000 millimeters equal 1 meter. The prefixes deca, hecto, and kilo are self explanatory.

It will take time and practice to become familiar with the basic units and the prefixes used with the Metric System. We hope that this introduction has been helpful.

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QUESTIONNAIRE

In order to determine how some mathematics teachers feel about using the hand-held calculator and/or use of the hand-held calculator in mathematics classes, the members of the MCATA are requested to please fill in this questionnaire.

This form has been designed to take a minimum of time to complete. The information you provide will be kept confidential and only summary data will be made public.

Please take the time to complete the form and return it to Ed Carriger, *Delta-K* Editor, RR1, Site 2, Box 3, Bluffton TOC OMO

Please circle the grade(s) in which you teach a mathematics class:

K 1 2 3 4 5 6 7 8 9 10 11 12 College University

For all but the final two items you are asked to mark how you feel about each statement using the categories Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), or Strongly Disagree (SD).

1.	More than half of the students I teach have a calculator at home.	SA	A	U	D	SD
2.	I personally have a calculator and use it often.	SA	A	U	D	SD
3.	Calculators have no place in the elementary classroom (K - 7).	SA	A	U	D	SD
4.	Calculators have no place in the junior secondary classroom (8 - 10).	SA	A	U	D	SD
5.	Calculators have no place in the senior secondary classroom (11 - 12).	SA	A	U	D	SD
6.	Calculators should only be used by "good" students.	SA	A	U	D	SD
7.	Calculators should be used by students who cannot remember their basic facts or skills.	SA	A	U	D	SD
8.	Calculators will keep students from learning their skills if used before junior secondary school.	SA	A	U	D	SD
9.	The school should buy the calculators for each class, just as they do books.	SA	A	U	D	SD
10.	Special courses should be designed that would use calculators for most of the computation.	SA	A	U	D	SD

11. Most parents I know are against the use of calculators in the schools. SA A U D SD

12. Special materials should be written to be used with the calculator. SA A U D SD

13. Students should be allowed to use the calculator on tests designed to evaluate problem solving ability. SA A U D SD

14. Calculators should be used to extend a student's problem solving ability. SA A U D SD

15. Students should be allowed to use calculators only to check their work. SA A U D SD

16. Calculators could lead to a complete breakdown in students learning basic skills. SA A U D SD

17. Textbooks should have special sections devoted to the use of the calculator. SA A U D SD

18. Special in-service courses should be given to teachers who wish to use the calculator in the classroom. SA A U D SD

19. Calculators will inspire students to continue in mathematics since they take away the drudgery of computation. SA A U D SD

20. Most people in the future will not have to do very much computation because machines will do it for them. SA A U D SD

21. I am convinced that "how to" use the calculator should be taught to every student before leaving secondary school. SA A U D SD

22. The calculator will be a big help to other classes besides mathematics.

23. The sooner we can get the calculator into the classroom the better. SA A U D SD

24. I have used calculators in my classes. YES NO

25. If you marked "YES" for number 24, would you please describe how you make use of the hand-held calculator in your class(es).

Thank you very much for taking the time to complete the form! We hope that you will return your complete form to the address on the reverse side of this form.