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Ontario Mathematics Gazette

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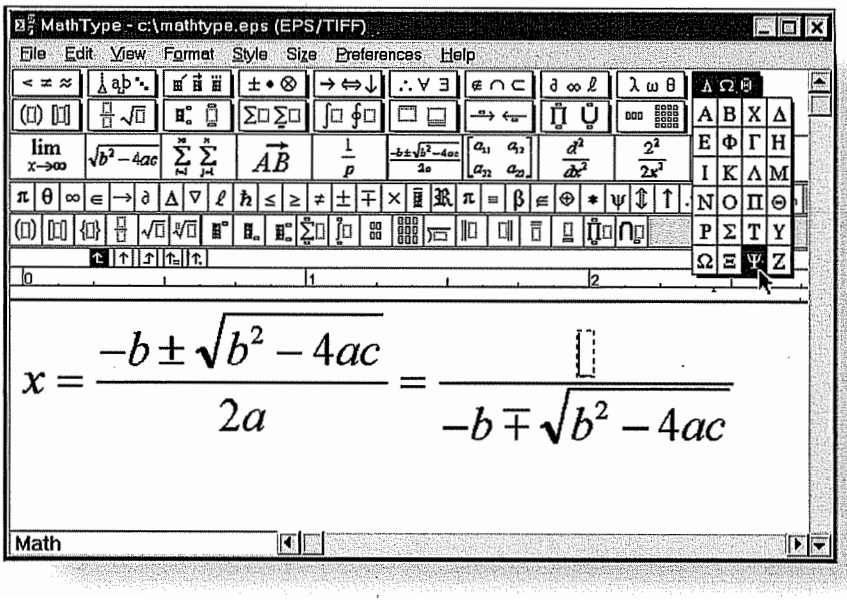
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▲ Editorial



JOHN EGSGARD

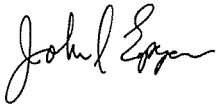
Once more we are at the beginning of a new school year. With the departure of many valued and experienced teachers to retirement we have a duty to help those who take their places to enjoy the thrill of teaching mathematics. As we know from our own beginning experience the first few months and year can be very challenging and sometimes demoralizing. We can not leave these new teachers to sink or swim on their own. It behooves all mathematics departments and teachers to go out of their way to help these novices teachers. When I began teaching just 50 years ago this month the help I received from my colleagues made me into an excellent teacher .

The *Gazette* will try to do its part in assisting teachers so do encourage your new colleagues to read your *Gazette.* Perhaps the mathematics department can even provide membership in OAME for these teachers in their first year.

In this issue you will find a thoughtful and timely article entitled **Some Thought on the New Mathematics Curriculum in Ontario**. Teachers of calculus should examine carefully the article **Calculus Midterm Test - Limits and Derivative Properties and Applications**. The article **Importing Graphs from Theorist into WordPerfect for Windows** and the two previous articles should be helpful to new and experienced teachers in using their computer to set tests. If you would like to have a mathematics toque for the winter months make use of the article **Math Toque**. Elementary teachers may find the article **Stories and Mathematical Concepts** especially helpful.

I spent the months of April, May and June supplying for the Yvonne Bergsma who is on maternity leave. I enjoyed teaching again but found that teaching takes up too many hours of the day after one has experienced the pleasure of retirement.

Good luck with the new school year.



Letters to the Editor

Dear Editor,

I was interested to read the **Teaching Ideas From The Editor** in the June 1998 *Gazette*. I, too, used to teach that the properties for x and y were different. However, there is another way in which transformations can be taught so that the changes related to x and y (and a third or fourth variable) are treated the same. I am convinced that it shows the relationship between the transformations and the resulting image equation more clearly than the algorithm suggested in the "Teaching Idea".

Consider y = f(x) changed into a(y+b)=f(cx+d). There has been a vertical stretch of $\frac{1}{a}$, a vertical translation of -b, a horizontal stretch of $\frac{1}{c}$ and a horizontal translation of -d. Thus both x and y could be considered "disobedient" to use the editor's description. The "disobedience" should be explained by considering some transformations.

For example: Given y = f(x), consider the transformation $(x,y) \rightarrow (x-4,2y)$ (i.e. a horizontal translation of - 4 and a vertical stretch of factor 2.) This means that x' = x - 4 and y' = 2y

So x = x'+ 4 and y = $\frac{y'}{2}$

Since y = f(x) , the image equation must be $\frac{y'}{2} = f(x' + 4)$.

We usually drop the primes in the image equation to give $\frac{y}{2} = f(x + 4)$.

This illustrates that the operations in the mappings are the inverse of the operations in the image equations, explaining mathematically the "disobedience".

Using these techniques, a student can analyse an equation in three dimensions.

For example if $x^2 + y^2 + z^2 = 1$ is changed to $(x - 3)^2 + (y + 4)^2 + (z - 1)^2 = 25$, the student will be able to detect a translation in the x direction of 3, a translation in the y direction of - 4 and a translation in the z direction of 1. A stretch has also taken place. To see the stretch, change the equation into transformational form.

$$\left(\frac{x-3}{5}\right)^2 + \left(\frac{y+4}{5}\right)^2 + \left(\frac{z-1}{5}\right)^2 = 1$$

Thus a stretch of 5 in the x, y and z directions have taken place.

Jeri Iunney

Dear Editor,

Here is an Open letter to all OAME members.

On the occasion of being honoured with this year's Mona MacGregor Award, I would like to this opportunity to compliment OAME members for their work in building enthusiasm for mathematics among Ontario's young people.

The Ontario Mathematics Olympics is the most innovative initiative in this regard that I have witnessed. The idea of developing a math competition, that combines teamwork with pure mathematics to create an exciting sports event that influences thousands of young people each year towards the study of mathematics at the start of their high school careers, is indeed impressive.

The first time I witnessed this competition in Ottawa in 1995, I was struck by both the sophisticated level of mathematical skill demonstrated by the "Mathletes" and the dedication of the teacher/coaches who had worked so hard to prepare their teams. It wasn't until 1996, however, when I attended a series of regional competitions involving hundreds of grade seven and eight students, that I realized the OMO's future potential to involve - and inspire — thousands of students each year. It was at that point that I recognized the true importance of the challenge undertaken by those math teachers who organize and participate in this annual competition.

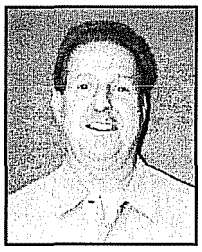
It goes without saying that the role of math educators is of considerable importance to the economic future of our province and our country. We must prepare our young people for careers in sciences, engineering and other technology-related fields. OAME members can rightfully take a great deal of pride in their contribution to making this goal a reality.

This has been a difficult year for Ontario teachers. Some educators in my acquaintance have questioned the worth given educators by society. For those math teachers who may feel unappreciated, I would like to say that, for every individual who excels in mathematics, whether in industry or other endeavors, there is a mathematics teacher whose skill, dedication and innovation inspired them to achieve excellence.

Thank you for advancing the cause of mathematics among so many of our young people.

Yours truly,
Peter Rose
Managing Partner
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▲ PRESIDENTS MESSAGE



RALPH D. CONNELLY

Greetings. I hope your school year is off to a good start. Keeping in mind the "time warp" thing I mentioned in my last message (I'm writing this in July, you're reading it in September), much will have happened by the time you read this.

As I write this, the "first deliverable" of the new **Secondary Math Curriculum** has appeared and OAME has reacted to it. In terms of sheer numbers of people responding, the feedback was a bit disappointing.

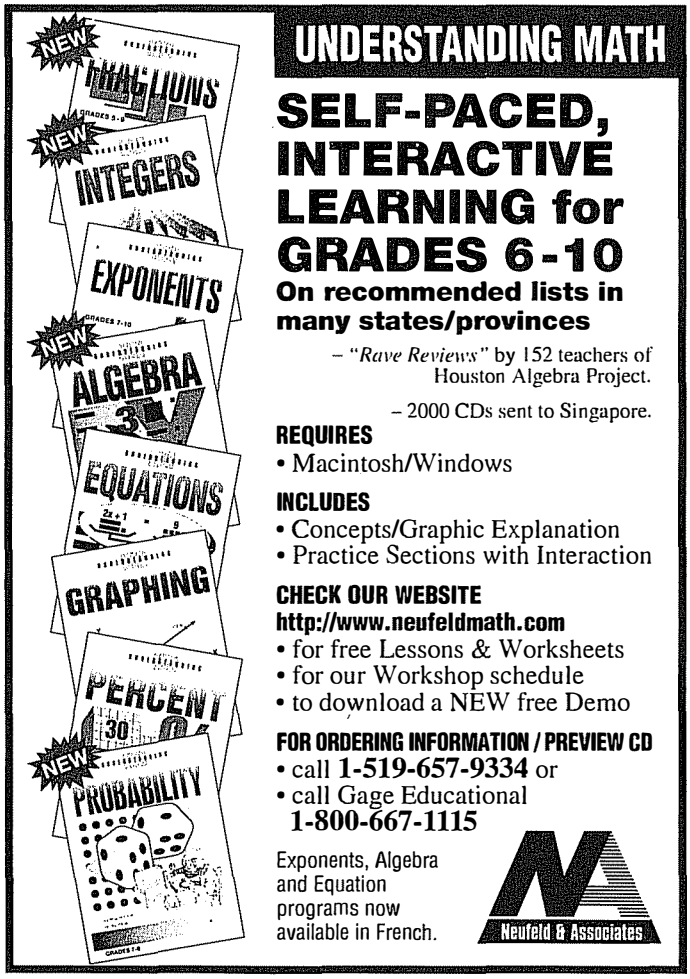
However, given the time of year (end of June) and all the things teachers were dealing with at that time, plus the extremely short "turnaround time" for feedback, I believe the OAME membership did very well in giving feedback/guidance to the writing team. I'm hoping that by the time you read this, participation in offering feedback to the second deliverable in August was even higher. Keep in mind that a third deliverable will be coming in October, and feedback from the OAME membership is crucial to the process! I hope those in a position to do so will be sure to make their views known. Also on the Secondary School front, OAME has a new publication, *Teaching with Technology*, that you should be sure to check out. Information about ordering this new publication appears in this issue.

For those in Junior and Intermediate grades, you'll want to check out the new OAME posters, which give a clear and organized view of the expectations for Gr. 6-8 for each of the strands of the Ontario Curriculum: Mathematics.

For Primary teachers, the year holds something for you, too. As you're reading this, we'll be in the process of getting assessment tasks from the upcoming **Primary Assessment Document** field tested. If you think you'd like to participate in field testing a task , call, write, fax, or e-mail me (think I've covered all the available technologies) right away and I'm sure we'll be able to use your help. The document should be ready by the end of this year or beginning of next.

For all of you who are NCTM members, be watching your mail for the **NCTM Election** ballot. For the first time since our own John Egsgard was elected President of NCTM, we have a Canadian candidate for President-Elect, Ian DeGroot from Vancouver, BC. I hope Ontario's NCTM members will be sure to vote, and I'd encourage you to support Ian's candidacy.

And last, but certainly FAR from least, be sure to use the registration form included with this *Gazette* to register for the **OAME Leadership Conference**, February 25-27, 1999 at the Four Points Hotel. At the secondary level, there will be workshops giving an early look at the new curriculum, and at the primary level, workshops based on the new Primary Years Assessment Document. Don't miss it!



▲ Some Thoughts on the New Mathematics Curriculum for Ontario

GORD NICHOLLS
FACULTY OF MATHEMATICS
UNIVERSITY OF WATERLOO

(Scenario – an old teacher is writing to his son, who is just starting his teaching career)

Dear Alexander,

As you begin your career and I come to the end of mine, both of us are being swept up in the great changes required to bring Ontario's school system in line with the other English speaking provinces. The process to reduce the Ontario high school programme from five to four years will require the best efforts and thinking of our teachers and educational officials so that we avoid most of the mistakes that potentially could be made in this major change to our school system. One way to avoid mistakes in the future is to learn from the past, both from the errors made in the past and also from the successes and positive experiences of those who did this type of work in previous years.

I wish you were closer so we could sit down and have some brain storming sessions like we used to have in the old days. Since the old gab session is impossible let me share the experiences of an old career mathematics teacher. I hope by sharing these thoughts , you will assess them and debate their merit with your friends on staff and any people in your area who will be doing the design work for the new mathematics curriculum.

1. THE SPIRAL CURRICULUM It is the opinion of many mathematics teachers that the concept of the spiral curriculum that was introduced in Ontario in the 1970's went too far. This is not saying there should be no spiral aspect to curriculum. In a subject like mathematics there will always be the need to return to concepts and skills that were learned in earlier years. What is required is a longer period of time for each topic. The new curriculum must allow enough time for the chosen topic to be developed to the point where the student can solve meaningful problems and also so the student can see how the new material fits into previously learned topics in mathematics. In specific terms this means it will be impossible to just slide the current grade 13 courses to grade 12 and then redistribute the current grade 9 to 12 material into the new courses for grades 9 to 11. I know I take the risk of being labeled as a modern Cassandra with the above statements, but I fear this is one of the biggest mistakes we could make in this revision. I hope you and your colleagues will be on your guard for this type of potential catastrophe.

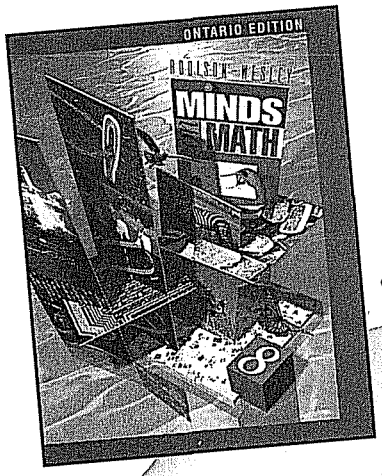
2. WHITEHEAD'S STAGE OF ROMANCE The 1985 curriculum did not allow time for teachers to address two important aspects of Whitehead's cycle of learning(1). The stress was on developing "precision" in a multitude of topics. In this new round of design we hopefully will correct this mistake and create a balance that will make allowance for the two missing phases. The stage of **'romance'** seems to be generating a lot of discussion under the name RLT (i.e. rich learning task). The label is not important, but it is important that teachers be given time to provide the introduction to a new topic that allows the students to experiment and 'muck about'. One thing I have noticed in some of the writing appearing on this topic is the claim that the only way to stimulate students is through a RLT. I remember this type of zealotry back in the 1960's when the only way to teach algebra was to begin with the generalizations from group theory and have the young students glory in all the beautiful patterns. In their enthusiasm the curriculum creators of that time forgot that those patterns only come to life when the learner has several specific examples to call upon. We in the classroom learned the lesson, but at the cost of giving thousands of students a dreadful experience. The big lesson to remember from those times is that no single approach is the magic answer for all teachers!

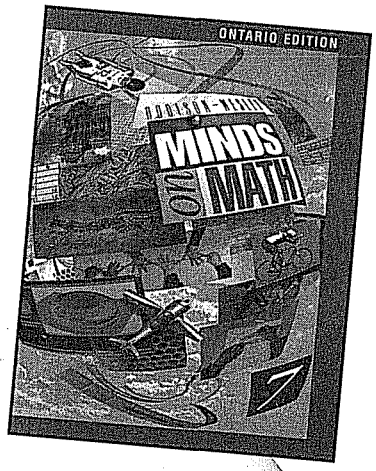
Although there has been a lot of discussion about RLT's there unfortunately has not been as much discussion about the necessity and importance of incorporating **Whitehead's stage of synthesis** into the new curriculum. This is important enough that I will list it as a separate item (see # 3).

3. WHITEHEAD'S STAGE OF SYNTHESIS In mathematics I think the synthesis stage, that Whitehead described in general terms, can be interpreted as a stage where the student learns to integrate the new topic (or technique) into his/her approach strategy to a collection of mixed problems. This is an area that

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students have traditionally found very difficult. In fact many teachers believe that only the very elite students are capable of achieving this synthesis. Over the period 1986 to 1995 I experimented with the synthesis stage by introducing sets of non standard problems to students at the grade 10 to 13 level at Preston High School. I presented the results of this experimentation to the OAME conference at the University of Guelph in May, 1995. It was my thesis that we could have significant success with the top quartile of a given age cohort provided the teachers were willing and able to do the marking that is required to make this synthesis work. I could not extend my thesis beyond this quartile because I never had enough time to extend the experiment to the General Level programme. Although we had about 50% of the age cohort in the Advanced programme, the approach we used was not successful with all students involved. We had perhaps a 50% success rate at grade 10 and that increased to close to a 100% success with the grade 13 students. I think this stage must not be overlooked if the new curriculum is to be effective. The proof of the curriculum's effectiveness will be in how well Ontario students will perform on national and international testing programmes. These tests usually combine a variety of skill questions with mixed problems that require the students to bring different problem solving techniques to bear on the problems. It will be too late in the year 2005 to say **we did not prepare the students properly!** The time to think about the concepts of **retention, mastery and the ability to use different**

approaches to problem solving occurs when you are designing the curriculum. I hope we will not repeat the mistake of the last two decades by not allowing enough time for this stage in the learning cycle.

4. EVALUATION In the last decade there has been a tendency by many teachers to set tests and exams that put too large a stress on skills. This is not to say that skills are unimportant. It is important, however, to have students evaluated in a consistent way across the province for other aspects in their mathematical development. The two other important aspects that should be evaluated are problem solving and the ability to write well explained solutions. To achieve these goals I would recommend that the following criteria be set into the curriculum document to steer the way teacher evaluation is conducted:

(i) The maximum value for skill type questions on tests and exams be set at x%.

(ii) Every test and exam must have problem solving component of at least y%.

(iii) In order to encourage full solution writing, tests and exams must have at least z% for full length essay style answers that will be marked for explanation as well as correctness.

(The values of x, y, and z would change in each grade. Clearly y and z would increase in the later grades For example in grade 9, x:y:z could be 7:3:4 whereas in grade 12 it might change to x:y:z = 3:7:8)

(iv) There must be more cumulative testing than has occurred in the past. In addition to the full term exam, another way to achieve this cumulative result would be to use the vehicle of non standard problem sets. This could be given official status in the curriculum document.(see section 3)

5. THE PREPARATION TRAP One of the most significant lessons we have learned over the years, in a cumulative discipline like mathematics, is the importance of the students preparation in the previous grade. Inside each school the local department head is in the position to ensure that this preparation is as consistent as different teaching styles will allow. We have, however, two transfer points in our system - the grade 8 to high school and the end of high school to post secondary. These are the points where students can get caught in the "preparation trap". The new K to 8 curriculum has been designed for a student oriented environment. The graduates of this new programme will feed into the new high school programme starting in September 1999. Is there going to be appropriate linkage between the two programmes? Was the new K to 8 curriculum designed with the idea that high school would be reduced to four years? Will the students have enough mastery of skills in arithmetic so they will be ready to proceed with algebra? Will students have had sufficient opportunities to develop problem solving strategies? Will the students be prepared for a subject oriented environment? In other words, will the students have been prepared in a rigorous enough programme so they can get on with a high school course that will be more demanding than the elementary programme? Will colleges and universities modify there first and second year courses to accommodate students who will arrive with less mathematical background than has historically been the case? These are questions that must be asked and answers must be found before the students enter the high school in 1999.

It has been a political decision to keep grade 7 and 8 under the same approach as that used for the earlier grades. Perhaps the time has come to introduce a transition approach for these grades and to upgrade the curriculum. Certainly in mathematics there is a large amount of grade 8 time devoted to review of grade 7 material. Since students learn at different rates, we know that for some students this is necessary; however, for a significant percentage of students, whose learning rate is faster, valuable time in their knowledge development is being wasted. I would propose that grade 8 be reorganized to two streams. To decide on which stream a student should take in mathematics the teacher should keep a profile throughout the grade 7 year using common tests written by all grade 7 students in the school. Students who are below the acceptable level would be required to take a grade 8 course that would have adequate review time in the programme in order to prepare these students on the fundamental requirements for high school. The students who had a successful grade 7 math profile would take a course that would have this review component replaced with some new topics and they would also devote more time to problem solving.

To help different elementary schools prepare their grade 8 students consistently and avoid the "preparation trap" we need to develop some cooperative approaches. One such approach would require all grade 8 students in a given school region to write a common mathematics test in December and then again in late May or early

June. To give an opportunity for professional growth, the committee that sets these tests should consist of a mix of grade 8 and grade 9 teachers. A common marking scheme would be provided to all teachers and the papers would be marked at the school level using a team marking approach. The results of these two tests would be used in conjunction with the teacher recommendation to determine which math programme the student should take in high school.

Looking forward to the year 2003, we also must develop some techniques to avoid the high school to post secondary preparation trap. It is clear to many math teachers that students graduating from high school be required to write an entrance exam in mathematics in order to help in their placement at the post secondary level. To provide professional growth for teachers, groups of math teachers would use a common marking scheme to mark the papers at several marking centres across the province. The results of such an exam should be used for placement and also shared with the post secondary institutions so they will be able to set their first year courses at the proper level. In addition the results should be shared with the high school teachers so they can determine the effectiveness of the preparation they provided to their students. A cooperative effort like this will give the first year students a smoother transition to the post secondary environment and hopefully avoid the statement often heard in lecture halls: "You were supposed to have learned this last year".

6. ORGANIZATION OF GRADES 7 AND 8 If we hope to have Ontario students score as high as students from British Columbia on the international and national math tests we must look at some of the changes made in B.C. over the last two decades. One of the significant changes they made was to require teachers at the grade 7-8 level to have studied several courses at the university in the subject they were teaching. The preparation in and the enthusiasm for mathematics amongst the cadre of grade 7 and 8 teachers in Ontario has been a concern in the mathematics community for some time. Since province wide data about the academic background of teachers is not available, it is necessary to make inferences based on the student enrollment at the faculties of education. For example, the current year at FEUT has a class of 150 in the junior/intermediate division, of whom 20 are enrolled in the optional specialist science course and 0 are enrolled in the corresponding math course! A similar situation has prevailed for several years with specialist math classes ranging in size from 8 to 15 out of a potential 150 candidates. Extrapolate these numbers to the province at large and it is not difficult to understand one of the major reasons why Ontario students are lagging behind students from other jurisdictions. Enthusiasm for mathematics is both a question of teacher interest and teacher workload. Most grade 7 and 8 classes are organized on the core teacher model, where the core teacher is responsible for the core academic subjects - usually english, history, geography and math. This is a tremendous workload and gives the teacher little time to keep up with one academic subject, let alone four. It is clear that we need to develop a new approach to school organization and to teacher preparation for the intermediate level. If this situation goes uncorrected, then we will have enormous difficulty in trying to improve the level of problem solving and increase the positive feelings about math for grade 7 and 8 students. An organization model that would allow the academic teachers a more realistic work load is required. This could be done by reducing the core teaching to two subjects with the obvious pairings being math with science and english with history/geography. To complement this organization it would be necessary for faculties of education to enroll equal numbers in the math/science and english/history/geography options for the junior-intermediate level. This situation will not be corrected before 1999, but significant progress could be made by 2005 if we begin this coming year. **Unfortunately, if government officials refuse to recognize the existence of the difficulty, then it will never be corrected.** Is this what we want for Ontario?

7. DESTREAMING In the early 1990's Ontario experimented with destreaming in grade 9. Although some teachers were able to achieve acceptable results, the feedback from a large number of math teachers labeled this approach to class organization a dismal failure. This immediately raises two questions. Why did the approach fail? and What should we do to correct the problem?

My analysis of the approach has led to the following conclusions.

First, most high school math teachers were not able to organize their classrooms into groups that could work through the programme at different rates. Either this was the fault of the teachers or the expectation was unreasonable. I think both were factors as the following personal experience will suggest. As I grew as a teacher in the mid years of my career I noticed that the needs of

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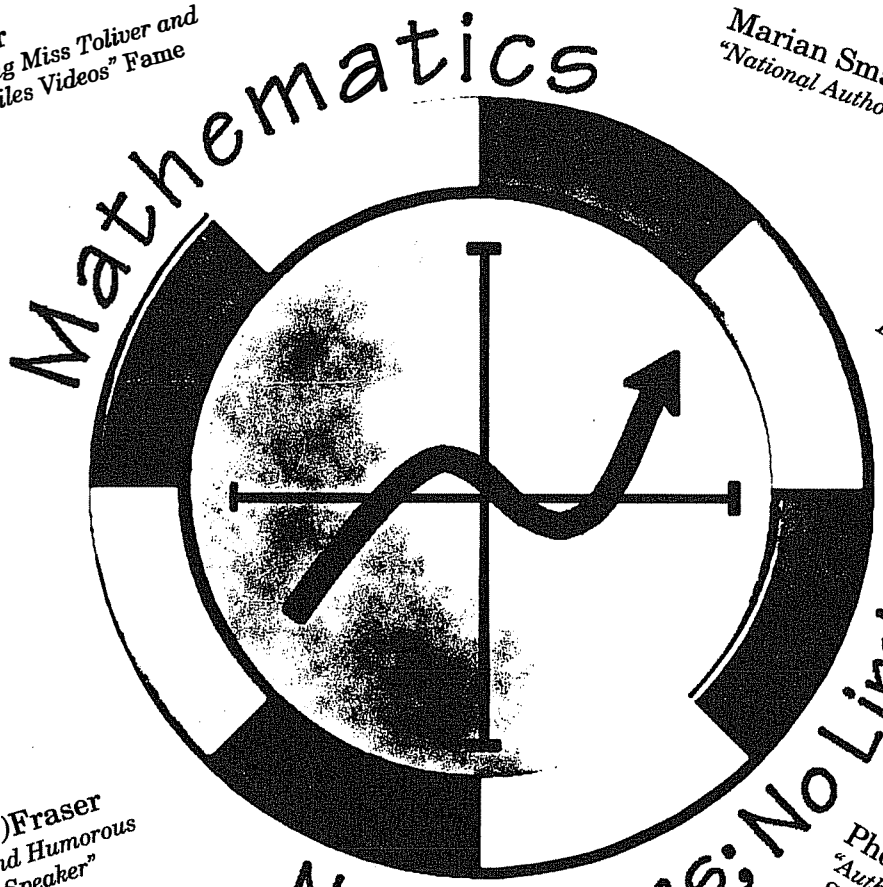
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*Logo designed by Greg Smith, student, Newmarket High School

the brightest students in the advanced level classes were not being met. The system I developed to stimulate these students was to provide them with homework assignments that had some problems not required of the other students. To make this work I had to make two adjustments to my class room management. (1) I allowed the students doing these harder problems to omit some of the simpler drill oriented problems. (2) I had to find time on a regular basis to discuss these problems in class. Both of these adjustments required extra work and better organization; however, as time passed by I grew comfortable with the approach. When I asked other teachers to implement this approach my experience as a department head was that some teachers were ready to implement this system but many were not at the point in their own personal development that they could comfortably handle so many things going on at the same time. There were four key components required to use this system. The teacher had to have: (i) good classroom control, (ii) excellent organization for the homework part of the period. Each group had to get a fair share!, (iii) confidence in problem solving, (iv) the energy to be active virtually every minute of the period. The first two of these components are automatic with all experienced teachers, but remember it takes from 5 to 10 years to acquire this experience. The third component comes to most full time math teachers; however, the time frame to achieve this confidence is very diverse. Some new teachers are gifted problem solvers and have been so since high school; whereas, some teachers take 20 years to acquire the confident handling of more difficult problems. This immediately presents a major constraint. The fourth condition favours the young. They have the energy to actively work from group to group throughout the period, but this energy is often inversely proportional to age!

Similar components are involved when you try to run a multilevel classroom. The dilemma we face is that some teachers have the key components in balance and are ready to operate in such an environment, but if we are honest we must admit that a significant percentage of our math teachers will not be able to do this effectively. **We must therefore not design a new grade 9 programme that requires math teachers to work in a destreamed classroom.**

The second conclusion I have drawn from the destreaming experiment is that it was an outright failure for two groups of students. I speak of the slow learning students who make up some 10% of the class and the brighter students who would comprise as much as 25% of a class. These students were neglected so the teacher could deal with the middle group which was almost never homogeneous. The net result of this type of organization was that the group of very needy slow learning students were in an environment where the pace was too fast and there was much they did not understand. At the other end of the spectrum a substantial percentage of students were bored and allowed to get away with mediocre performance while being rewarded with very high marks. If we can not change the system because of the difficulties experienced by teachers, surely we must change it for the students.

Second, to correct the destreaming error and at the same time face the political problem of not trapping students too early in their high school career **we need to design a system that will take into account different learning rates and slower maturing students.** Since very few things come for free in life, there will unfortunately be a price to pay to achieve a system that will both stream students and allow flexibility. I think this could be achieved if we created two new grade 9 and 10 streams for mathematics. One of these streams would prepare students to enter the senior years in the academic programme. In the other stream students would study some of the same topics, but they would move at a slower pace and they would also study some practical topics that every student should know as part of living skills. After grade 10 we should offer a transfer course, that would be required if a student wanted to move from the lower level course to the grade 11 academic course. This transfer course would fill in the missing topics and put more emphasis on problem solving. This would provide the opportunity for the late maturing student to still enter the academic programme if they so desired and were willing to do the work.

The hour is late Alexander and I have to be up early tomorrow. I hope the memories of an 'old fox' have not been too lengthy and critical for a young idealist like yourself. I know we can do a better job of teaching mathematics and I have every confidence that your generation will rise to the challenge. I hope, however, you can make progress without repeating some of the mistakes that we made. When you have time share your reactions with me. I trust you will find several points that will be debatable— you always do!

Love, Dad

(1) Whitehead, A. N. ; *The Aims of Education*

▲ MATH TOQUE

MARLENE GRIFFITHS



I have been a spinner and knitter for many years, and especially enjoy designing and making my own patterns.

Several years ago I started making designer toques for various people. I made one for a lawyer who was heading for the North with "HERE COMES THE JUDGE" on it, and have made several for dancer friends with dance team names and dance references on them.

A few years ago I made a Math Hat for my husband , who is a math teacher, involved in preparing students for contests as well as in local and provincial math organizations. At a Mathematics conference it was suggested the design be submitted to the Gazette so that other interested Math teachers could knit or have someone else knit them a Math toque too. In answer to this suggestion I offer the design, both pattern and graph, for the use of anyone interested in making a toque.

MATH TOQUE (As shown on cover.)

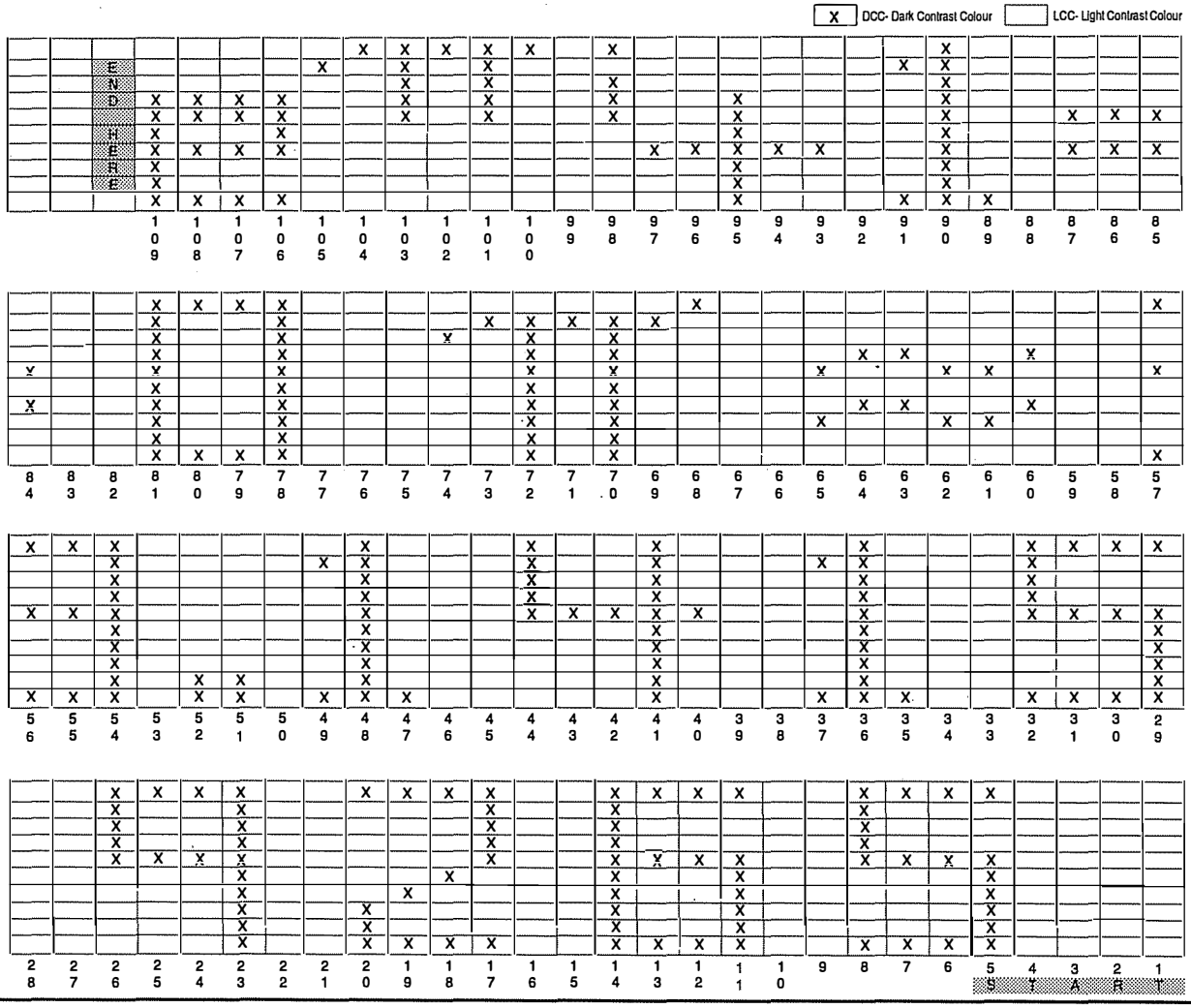
Needles: 4mm dbl pointed, optional 4mm circular (40cm)

Yarn: MC – Main Colour (Red) – 100gr
DCC – Dark Contrast Colour (Navy) >50gr
LCC – Light Contrast Colour (White) >50gr
Contrast colours good for using up odds & ends of leftovers

Stitch Gauge: 20sts = 3 inches and 20 rows = 3 inches on K1,P1 ribbing

ROUNDS: 1-36 Cast on 110 sts with MC (red); join and knit circular in K1,P1 ribbing for 36 rows, for lining.

GRAPH of $e^{\pi i} + 1 = 0$ $\pi = 3.14159265$



Change to Knit each round.

ROUNDS:

37 Knit 1 round MC.

38 Purl 1 round MC.

39-50 Knit 12 rounds MC.

51-52 (K1 DCC, K1 MC) repeat around.

53 Knit 1 round DCC.

54-55 (K1 LCC, K1 DCC) repeat around. Dec. 1 st in round 55.(109sts)

56-57 Knit two rounds LCC.

58-67 Knit following the GRAPH reading from right to left. [X] - DCC; [ ] - LCC.

68-69 Knit two rounds LCC. Inc. 1 st in round 67.(110sts)

70-71 (K1 LCC, K1 DCC) repeat around.

72 Knit one round DCC.

73-74 (K1 MC, K1 DCC) repeat around.

75-94 Knit 20 rounds MC.

Decrease as follows:

ROUNDS:

95 K2 tog around (55sts)

96 Knit around.

97 K2 tog around, ending K1

98 Knit around.

99 K2 tog around.

100 Knit around.

101 K2 tog around.Break yarn;pull through remaining sts; fasten off.

Finishing: Turn ribbed lining to inside of togue at purl row ridge and sew in place, being careful not to pull too tight.

ORIGINAL PATTERN BY:

Marlene Griffiths
985 Thistledown Way
LONDON, ON, Canada
N6G 4L6
PHONE: 519-471-5193
E-MAIL: tgriffit@julian.uwo.ca

▲ Nominations for OAME/AOEM Board of Directors 1999-2000

Each year, elections are held for President-Elect, 3 Vice Presidents (1 year term) and 6 to 9 Directors (3 year term) of OAME/AOEM. Nominations for these positions are to be submitted by 4:00 p.m., January 15, 1999, to:

Judy Crompton, Past President OAME/AOEM

Include the nominee's qualifications with the Nominations Form. A nominee must be a member of OAME. By March, 1999, the Nomination Committee will publish a slate of candidates, including qualifications, for consideration by the membership. Voting will be by mail and is open to all OAME/AOEM members. The election will be released at the Annual General Meeting of the OAME/AOEM in Richmond Hill in May, 1999.

Nomination Form

I nominate: _____

For the position(s) of: ☐ President-Elect ☐ Vice-President ☐ Director

Nominee's Address: _____

_____

Telephone: H ( ) _____ W ( ) _____

Nominator's Address: _____

_____

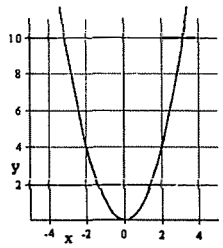
Telephone: H ( ) _____ W ( ) _____

▲ IMPORTING GRAPHS FROM THEORIST INTO WORDPERFECT FOR WINDOWS

GREG CLARKE



Greg is the Chairperson for Information Technology & Science at Patrick Fogarty Secondary School in Orillia, Ontario, as well as the school's Computer Site Administrator and acting Math Department Head. He graduated from the University of Waterloo and is presently in his tenth year of teaching.



When doing a test, handout, or assignment sheet, it is often necessary to include GRAPHS. It is possible to generate most of these graphs with a computer program like Theorist or Green Globs or Zap-A-Graph, and then insert them into your test, handout, or assignment document in WordPerfect, or any other word processor. These graphs would be inserted as graphics, in a WordPerfect graphics box. The following process will work with any Windows based graphing program, and WPerfect.

The process that should be followed is similar to the process to **IMPORT DIAGRAMS from PAINTBRUSH into WORDPERFECT for WINDOWS.** (In this example, I'm using Theorist, but similar steps work for any other program.)

STEP ONE: Go to THEORIST to DRAW your graph.

1. If you are currently in WordPerfect, press ALT+TAB to get to the Program Manager.
   NOTE:
   ** Pressing ALT+TAB takes you from one Windows program to another. It is possible to run many programs at the same time in Windows.*
   ** To see a list of programs that are running at any one time, press CTRL+ESC , or you can HOLD DOWN the ALT key, while pressing the TAB key repeatedly.*
2. Start the THEORIST program.
3. Draw your graph.
   (Enter your equation. Highlight equation. Choose GRAPH and appropriate type, usually LINEAR.)

STEP TWO: Copy the graph just drawn.

1. Go to the EDIT menu, and choose COPY AS PICTURE to save this graph to the Windows Clipboard. *(temporary memory)*

STEP THREE: Return to WordPerfect.

1. Press ALT+TAB to return to WordPerfect (or, you may have to try CTRL+ESC, or HOLD down ALT, and press TAB a number of times).

STEP FOUR: Paste your graph into the WordPerfect document.

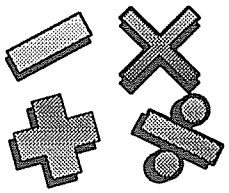
1. Once you are in the WordPerfect screen, choose EDIT - PASTE.

STEP FIVE: Position your graph, and adjust the Graphics Box settings, if needed.

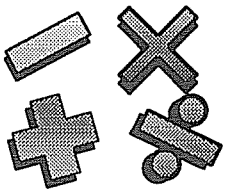
1. Use the mouse to position your graph so that it is at the right place on the page.
2. Right-Click on the Graph, and a Menu will pop-up —> Choose Edit BOX POSITION.

BoxType	**FIGURE** = an outline around your graph	**USER BOX** = no outline
Wrap Text Around Box	**Checked** = text will go around graph, or be bumped out of the way of the graph.	**Un-Checked** = text will go over top of graph, if necessary, graph will appear as a background image, having no formatting effect on the text whatsoever.
NOTE: To Select a Graphics Box that is in the Background, like this one, Right-Click on it with the mouse.		

3. Click OK, and then continue with WordPerfect. (Good idea to save after every graph is pasted.)



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▲ CALCULUS MIDTERM TEST

LIMITS AND DERIVATIVES: PROPERTIES AND APPLICATIONS

FRANCES SCHATZ & ANITA SCHATZ



As a free-lance mathematics teacher and writer Frances Schatz's main interests are tutoring and teaching transition and senior mathematics. She has had craft patterns and mathematics ideas published.



Anita, who is a technical writer with Waterloo Maple Inc., a mathematics software firm, provided the technical expertise in the design of this multiple-choice test.
Both Frances and her daughter, Anita, are UW Mathematics graduates.

For night school term work, I use different assessment tools; weekly journal, regular assignments, and a variety of test formats including short answer, full solution and multiple choice. Multiple choice questions leave no place for part marks. In fact, an arithmetic error has the same result as an error in reasoning. This test marked out of 50 was just one of 7 tests (each marked out of 50) for the course.

Two hours, a scientific calculator and graph paper were allowed for this test. Students were asked to hand in all rough work. One mark per question was possible if rough work showed a good solution but the wrong answer was chosen on the test.

In my class of 17 students, one scored perfect and two were below 50%. The mean was 34 and the median was 32 with range 22-50. Several students earned a maximum of 3 marks on rough work. All marks were close to marks earned on short answer or full solution tests. It is not fair to have an all-multiple choice exam but I do encourage multiple choice experience for pre-university preparation.

Note: *The following exam pages can be enlarged 200% for reproduction or 300 dpi bitmap jpeg files can be downloaded from our web site then printed out.*

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Calculus Midterm Test
Limits and Derivatives: Properties and Applications

1. The slope of the tangent line to the rectangular hyperbola $y = \frac{-2}{x}$ at the point $(-\frac{1}{3}, 6)$ is

(A) 27 (B) 18 (C) $\frac{2}{9}$ (D) 6 (E) -12

2. A construction worker drops a wrench while working on a high-rise building 320m above the ground. After t seconds the wrench has fallen a distance s metres where $s(t) = -5t^2 - 3t + 320$. The average downward velocity of the wrench between the times $t = 2$ and $t = 3$ is

(A) 13 m/s (B) 33 m/s (C) 23 m/s (D) 28 m/s (E) 10 m/s

3. The $\lim_{x \to 2} \frac{\sqrt{3-x} - \sqrt{x-1}}{6-3x}$ is

(A) 1 (B) $\frac{2}{3}$ (C) $\frac{3}{2}$ (D) $\frac{1}{2}$ (E) $\frac{1}{3}$

4. $\lim_{x \to 2} \left(\frac{x^3 - 8}{x^2 - 3x + 2} \right)$ equals

(A) 12 (B) 16 (C) $\frac{3}{2}$ (D) -2 (E) ∞

5. $\lim_{x \to \infty} \left(\frac{4x^2 - x + 3}{1 + 5x - 6x^2} \right)$ equals

(A) 3 (B) $\frac{2}{3}$ (C) $-\frac{3}{2}$ (D) $-\frac{2}{3}$ (E) 0

6. $\lim_{x \to -\infty} \left(\frac{x^2 - 5x^3 - 7x^4}{7x^4 - 14x^2 + 1} \right)$ equals

(A) DNE (B) 0 (C) -1 (D) $-\frac{1}{14}$ (E) $\frac{5}{14}$

7. $\lim_{h \to 0} \frac{\frac{1}{\sqrt{x+h+2}} - \frac{1}{\sqrt{x+2}}}{h}$ is the definition of the derivative for:

(A) $f(x) = \sqrt{x+2}$ (B) $f(x) = -\frac{1}{\sqrt{x+2}}$
(C) $f(x) = (x+2)^{\frac{1}{2}}$ (D) $f(x) = \sqrt{x+h+2}$
(E) $f(x) = (x+2)^{-\frac{1}{2}}$

8. $\lim_{\Delta t \to 0} \frac{(-2+\Delta t)^4 - 16}{\Delta t}$ equals

(A) 0 (B) ∞ (C) $f'(-2)$ where $f(t) = t^4$
(D) 16 (E) $f'(t)$ where $f(t) = (-2)^4 t$

9. The slope of the tangent to the curve $y = 2\sqrt{x} - 3x + 4$ at the point $(4, -4)$ is

(A) $\frac{5}{2}$ (B) -2.5 (C) 1 (D) 13 (E) $\frac{3}{2}$

10. The minimum value of $f(x) = 5\sqrt{1+x^2} + 3(4-x)$, where $0 \le x \le 4$ is

(A) $\frac{3}{4}$ (B) $5\sqrt{17}$ (C) 16 (D) 17 (E) 12

11. The equation of the tangent to the graph $y = x^2 - 4x + 5$ at the point (1,2) is

(A) $2x + y - 4 = 0$ (B) $2x - y + 4 = 0$
(C) $y - 2x + 4 = 0$ (D) $x - 2y + 4 = 0$
(E) $x + 2y - 4 = 0$

12. The tangent to the curve $y = x^3 - 3x^2$ is parallel to the line $y = 9x + 7$ at the points

(A) $(1, -4), (3, 0)$ (B) $(-1, 4), (3, 0)$
(C) $(-1, -4), (-3, 0)$ (D) $(-1, -4)\ (3, 0)$
(E) $(1, 4), (3, 0)$

13. The coordinates of the point on $y = 3x^2 - 4x$ where the tangent is parallel to $y = 8x$ are

(A) (2, 1) (B) (2, 2) (C) (1, 2) (D) (2, 4) (E) (4, 2)

14. The maximum value of the function $f(x) = 3x - x^2$ occurs at:

(A) $x = 0$ (B) $x = 2$ (C) $x = \frac{1}{2}$ (D) $x = \frac{3}{2}$ (E) $x = \frac{2}{3}$

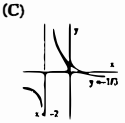
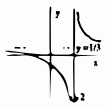
15. The minimum value of the function $f(x) = -3x^2 - 5x + 4$ on the interval $-2 \le x \le 3$ is:

(A) 4 (B) 2 (C) -6 (D) $\frac{73}{12}$ (E) -38

16. The minimum value of $y = \frac{x^2 - 1}{3x - 5}$ for the domain $x > \frac{5}{3}$ is

(A) -3 (B) 0 (C) $\frac{2}{9}$ (D) 2 (E) 3

17. Which of the following curves "best" represents the graph of $f(x) = \frac{2-x}{3x+6}$?

(A) 
(B) 
(C) 
(D) 
(E) 

18. At what point on the curve $y = x^2 - 4x + 7$ does the normal to the curve have a slope of $-\frac{1}{6}$?

(A) (12, 5) (B) $(\frac{25}{12}, -\frac{167}{144})$ (C) $(\frac{23}{12}, -\frac{73}{144})$ (D) $(\frac{1}{6}, \frac{229}{36})$ (E) (5, 12)

19. Given $f(x) = 3x^5 - 20x^3$, find all values of x for which $f(x)$ is concave up.

(A) $x > 0$ (B) $\sqrt{2} < x < 0$ and $x > \sqrt{2}$ (C) $-\sqrt{2} < x < 0$ and $x > \sqrt{2}$
(D) $x > \sqrt{2}$ (E) $-\sqrt{2} < x < \sqrt{2}$

20. Given $f(x) = \frac{x^2 - 1}{x^2 - 4}$, determine what intervals of x make $f(x)$ an increasing function.

(A) $-2 < x < 2$ (B) $x < -2$ and $x > 2$ (C) $x < -2$ and $-2 < x < 0$
(D) $x > -2$ and $x < -2$ (E) $-2 < x < 2$ and $x > 2$

21. If $y = 3\sqrt{u}$ and $u = x^2 + 3$, find $\frac{dy}{dx}$ at $x = \sqrt{6}$.

(A) $9\sqrt{6}$ (B) $\sqrt{6}$ (C) 9 (D) 81 (E) $3\sqrt{39}$

22. When the area in square metres of an expanding circle is increasing twice as fast as its radius in metres, the radius in metres is

(A) $\frac{1}{4\pi}$ (B) $\frac{1}{4}$ (C) $\frac{1}{\pi}$ (D) 1 (E) π

23. If $3x^2 + 2xy + y^2 = 2$, then the value of $\frac{dy}{dx}$ at $x = 1$ is

(A) not defined (B) 4 (C) 2 (D) 0 (E) -2

24. Water is pouring into a conical tank at a rate of 50π m^3/min. ($V = \frac{1}{3}\pi r^2 h$) If the tank has height 12 m and radius of the top is 6 m, find the rate at which the water level is rising at the instant when height is 4m.

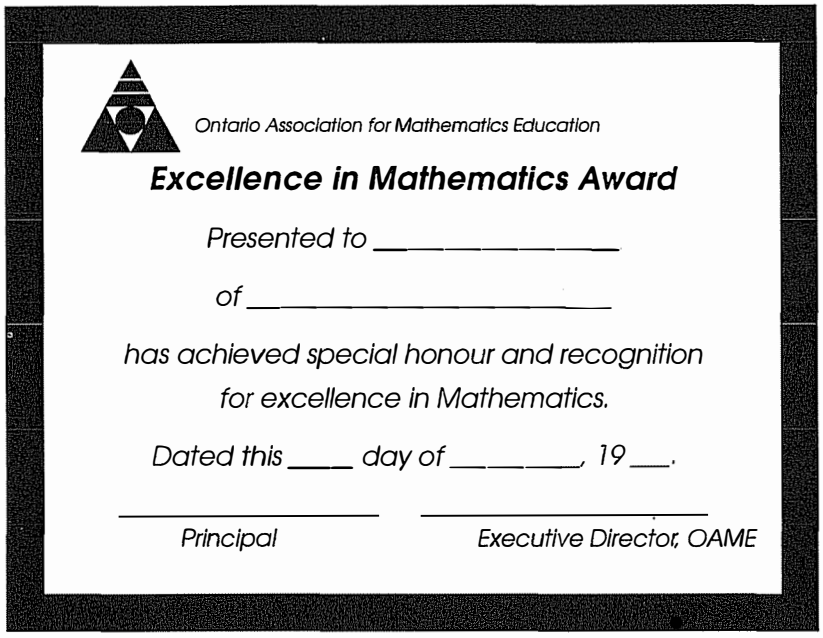
(A) 2 m/min (B) 4 m/min (C) 5 m/min (D) 12.5 m/min (E) $\frac{25}{2\pi}$ m/min

25. Kristin wants a rectangular box with an open top to be constructed from a piece of cardboard 40 cm by 24 cm, by cutting out a square from each of the four corners and bending up the sides. Find the side of the square to be cut out to the nearest centimetre so that Kristin's box has the largest possible volume.

(A) 3 cm (B) 4 cm (C) 5 cm (D) 6 cm (E) 7 cm

Answer Key

(1) B	(2) D	(3) E	(4) A	(5) D	(6) C	(7) E
(8) C	(9) B	(10) C	(11) A	(12) D	(13) D	(14) D
(15) E	(16) D	(17) C	(18) E	(19) C	(20) C	(21) B
(22) C	(23) A	(24) D	(25) C			



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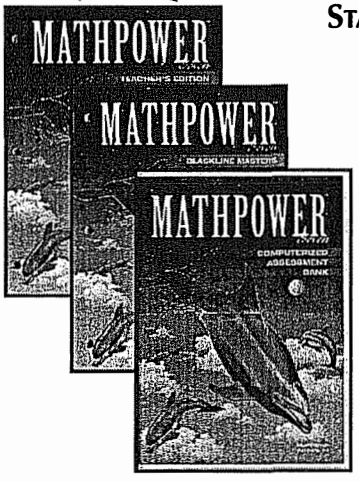
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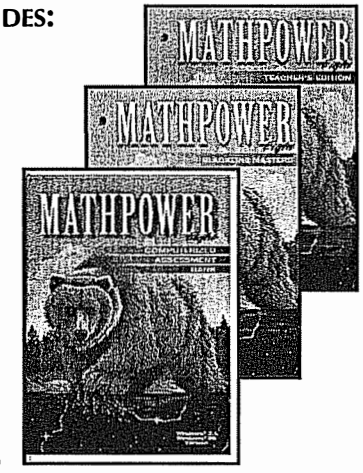
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▲ Stories and Mathematical Concepts

GERALD R. OGLAN
ASSOCIATE PROFESSOR
COLLEGE OF EDUCATION
WAYNE STATE UNIVERSITY
DETROIT, MICHIGAN



Prior to teaching at Wayne State Gerry taught K-8, intermediate learning disabled students and served three years as an assistant co-ordinator for the Windsor Public Board of Education.

TODD ROMIENS
UNIVERSITY OF WINDSOR
WINDSOR ONTARIO



Todd spent thiry-five years with the Windsor Public Board as a teacher, department head and assistant coordinator in mathematics education. He nows works in teacher training at the University of Windsor.

A group of grade 7 students listen as their teacher reads them a story:

Once upon a time in a land far away, there lived a benevolent ruler, Queen Elipower the second (or Elipower squared) as she was known to her closest friends. Queen Elipower ruled her land from a great stone castle. With her, in the same castle, lived a band of brave knights that helped keep peace in the land.

Each day the knights practiced fighting with swords, hunting and jousting to keep their physical skills at a high level. To stimulate their minds they did math problems, crossword puzzles and played games like chess and checkers.

One day a group of villagers came to the castle. "Your majesty," they said to the queen, "a huge dragon has come to live in a cave near us. He breathes fire and smoke. We are afraid for our lives."

The queen summoned her knights and said, "Go find this dragon. You can't miss him. He roars a lot and breathes fire and smoke. Deal with him."

As the knights drew closer to the dragon, they heard roaring and saw the smoke. "Those flames will melt our armor," they shouted, "let's get out of here."

"Sorry your majesty," they said to the queen.

"Some knights you are!" Exclaimed the queen, "Where is my favorite knight Sir Galimath? Send for him immediately!"

Sir Galimath was engaged in a chess game with a local resident when he got the call. He left immediately for the castle.

When he arrived, the queen explained the situation. Sir Galimath left to find the dragon immediately. It did not take long before he was face to face with the dragon. Lesser men (like the knights before him) would have been intimidated by the large fangs, smoke and fire bellowing from the enormous dragon.

Undaunted, Sir Galimath drew his sword. With a single thrust the dragon was slain.

Triumphantly, Sir Galimath returned to the castle, amid the cheers of the town's people. The queen granted Sir Galimath one wish.

Sir Galimath thought for a moment, and being a chess player asked for the following:

"The chess board has 64 squares (see Figure 1). Let each square represent a day. Starting on day one (the first square) I would like 2 grains of wheat. On each day thereafter I would like the number of grains of wheat doubled until the 64th day." The queen granted his wish.

Students thought about the story and wrote questions about Sir Galimath's request:

Why did he choose grain?

I wonder why he did not wish for money?

Did he make a good decision?

I wonder how much grain this involves?

Why didn't the queen just offer him a sum of money?

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

Figure 1: The Chessboard

Students explored the concept of doubling using calculators to find out how much grain Sir Galimath would receive each day. Students marveled at the volume of grain he would accumulate by the sixty-fourth day. Students started wondering and making connections to other environments:

"What if he would have asked for two nickels each day?"

"What if the number of people starting to smoking doubled each day?"

"What if two people a day discovered they had cancer?"

The questioning process helped students construct knowledge, discover relationships, and develop a greater and broader understanding of the concept of doubling. The numerical value had more meaning when students applied it to other environments such as money, smoking, drugs, and diseases. The concept of doubling applied to cancer, smoking, and money was more meaningful because of the Sir Galimath story. The story provided an overall picture of the environment and setting allowing students to direct their attention to the meaning of the story. The questions' students posed acted as a starting point for their inquiry. Rosenblatt (1980) would say the students lived an event, through an aesthetic experience.

Meaning and Mathematics

Halliday (1975) states that any literacy engagement has the potential for people to learn language, learn about language, and learn through language. This occurs as they share their wondering questions, retell events and listen to other perspectives, while actively pursuing answers to their inquiries.

Halliday's model serves as a lens to view mathematics. Tell the students a story in which mathematics exists and then let them wonder about the details. Students develop ownership of their learning, wonder about possibilities, create mathematical probabilities, pursue problem solving, and generate a variety of solutions. Story telling (usually related to reading instruction) can apply to mathematical concepts. Stories act as a framework from which wondering can occur. Stories involve calculating the distance covered by ink from a pen, speculating about the number of offspring from an Irish Setter, or questioning why a camel's upper lip is split begin with wondering questions (Whitin & Wilde, 1995). Mathematical environments combined with the use of story allow students to explore mathematical concepts and relationships.

Mathematical Environments: What Are They?

Mathematical environments are places where math exists. They are everywhere: restaurants, stores, playgrounds, baseball diamonds, kitchens, laundry rooms, flower blossoms and automobile hubcaps. As mathematics teachers share their stories about mathematical environments, learning through wondering questions can become a reality.

Automobile hubcaps provided the setting as a natural environment to explore geometry and other related concepts. Students in a grade seven viewed a series of pictures of hubcaps, looked at hubcaps in the school parking lot, and examined the hubcaps on their cars at home. They looked for geometric shapes, angles, or lines of symmetry. Conceptually students discovered line symmetry (see Figure 2), rotational symmetry (see Figure 3), and applied what they learned by creating their own hubcaps.

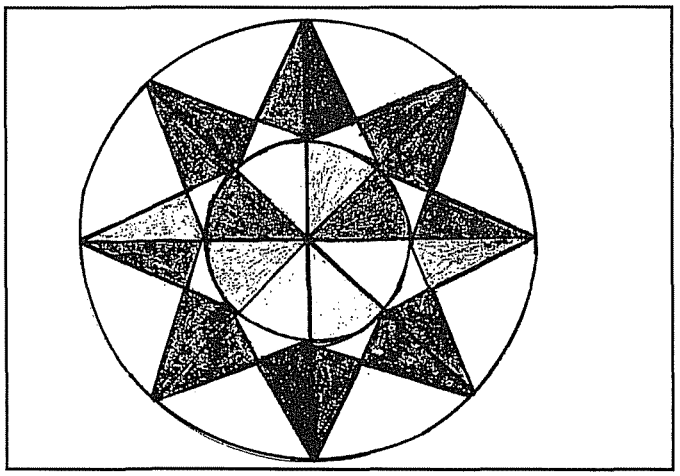


Figure 2: Hubcap with Line Symmetry

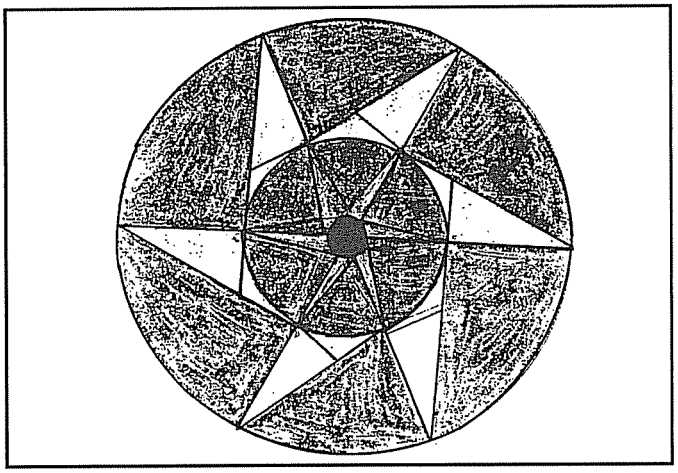


Figure 3: Hubcap with Rotational Symmetry

Viewing mathematics as a generative process led to the exploration of other concepts. For example, exploration of hubcaps led to inquiries about the pentagon (see Figure4) which is the fundamental shape used by the Chrysler Corporation as their trademark. Exploring its properties led students to discussing ratio, percent, and the golden rectangle.

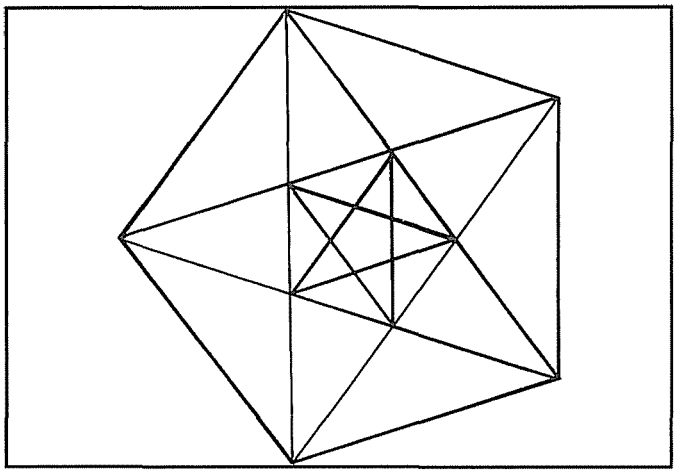


Figure 4: Pentagon

Inquiry: A Transactive Process

Observing the grade seven students generated the patterns in their thinking. Thinking was prefaced with an utterance like, "Mmm, that sounds interesting." This utterance preceded a predictable statement like, "I wonder..." This led to a desire to try out hypotheses, reconsider those that worked and did not work, and then share them with others. Students exclaimed, "Aha!" at various moments when conceptual connections to rotational and line symmetry were discovered. Inquiry represents a transactive model (see Figure 5) highlighting the metacognitive process that learners' experience.

"MMM" That sounds interesting and is something I want to pursue.
"I Wonder" (Inquiry) What questions come to mind? How should I proceed?
"Let Me Try" (Risk Taking) Which technique should I try? Do I have more questions? Should I involve others?
"Try Again" (Reflecting) Was my method good? Did it lead to a reasonable conclusion?
"AHA" (Connections) I see now! The results seem reasonable. Do my conclusions lead to more questions?
"Let Me Tell You About It" (Communicating) I want to share this information.

Figure 5: Transactive Model

This model supports the following beliefs about learning:

- Mathematics is best learned in the context of real-life experiences.
- Students have a diverse understanding about mathematics.
- Learning mathematics is enhanced through collaborative classrooms and curriculums that encourage and support risk taking.
- Evaluation must involve students and their parents.
- Students are in control of their learning when they actively engage in experiences that foster a sense of ownership.

When teachers use environments, learning is viewed apart from traditional thinking. "Problem solving suggests a right answer; inquiry suggests alternative answers as we unpack the complexity of issues. Problems are not something to be avoided, but opportunities to inquire" (Short, Harste, Burke 1996). When students view problem solving as inquiry, in essence they view themselves as part of the problem and part of the solution. Thus a transactive model is in effect. Dewey (1939) identified experiences that live on in further experiences as "educative" inferring a connection between learning with purpose and meaning.

Mathematical environments provide purpose and meaning giving students opportunities to make "connections" to mathematical concepts. Figure 6 represents beliefs that support transactional learning theory (Weaver, 1989).

- Students actively pursue learning and construct knowledge.
- Teachers develop and negotiate the curriculum.
- Responsive teaching will meet the needs and interests of students.
- Students form and test hypotheses.
- Errors are necessary for encouraging more sophisticated hypothesis.
- Mastercraftsperson or mentor: emphasis on demonstrating, inviting, discussing, affirming, facilitating, collaborating, observing, and supporting.
- Mini-lessons used as demonstrations.
- Students discuss, and add ideas and strategies.
- Learning is individual, different for everyone.
- Multiple means of assessments provide a broader understanding of the learning process.

Figure 6: Belief in Support of Transactional Learning Theory

Assessing Mathematical Environments

Learning logs, were used by the students to explain how the information they learned about hubcaps helped them to design their own. Student interviews, self evaluations, peer evaluations, and a strategy called, "Three Pluses and A Wish (see Figure 7) allowed students to reflect on their learning.

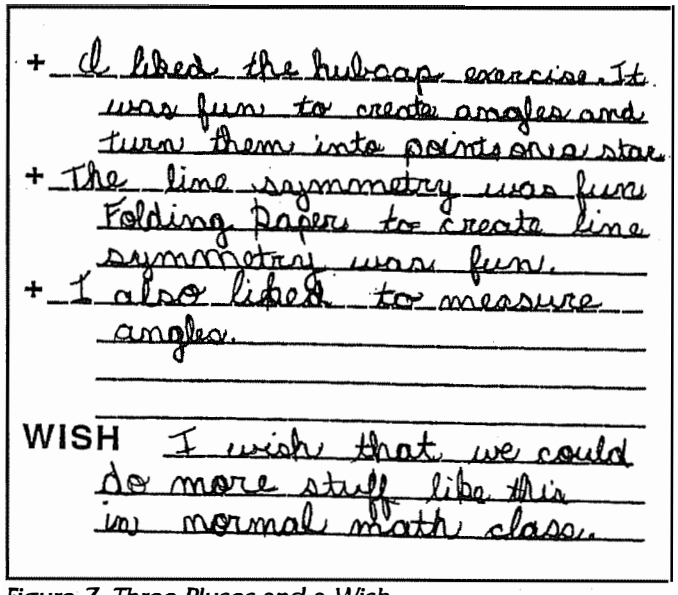


Figure 7: Three Pluses and a Wish

Students identified three things they learned or liked about mathematical environments and one thing they wish they knew more about. The following reflect some of the pluses and wishes made by students after designing their hubcaps:

Pluses:

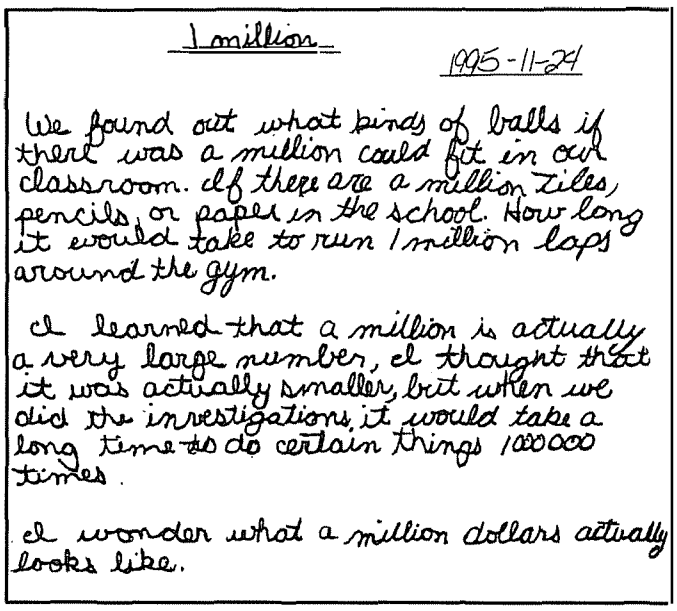
- I think it was good that we learned about the shapes in a hubcap.
- It made me think about looking at them for the shapes.
- I think it was good to learn about the different angles.
- I liked the idea that we made hubcaps to help us with our math.
- It was fun to create angles and turn them into points on a star.
- Folding paper to create line symmetry was fun.
- I was not good at line symmetry and this helped me.
- I liked the star that appeared in the pentagon when the diagonals were connected.
- I liked how we got degrees from the angles.
- I learned a lot about shapes and I liked working on the hubcaps and designing them and I learned a lot of new math.
- I think you know how to have fun with math by designing our own hubcaps.

Wishes:

- We could do more stuff like this in normal math class.
- To have fun and learn at the same time.
- To learn more about how to design hubcaps.
- To expand my vocabulary in math.
- To look at what math can do in the real world.
- To find more math around us, stuff like that.

Classroom Implications

When students have experiences based on an inquiry model they make connections between what is being learned and their personal growth as mathematicians. They discover inquiry as a useful tool for exploring their world and sharing their discovery with others (Whitin, Mills, O'Keefe, 1990). Curriculum is not what you cover, but what you uncover. The following represent examples of student reflections (see Figures 8, 9, and 10).



1 million

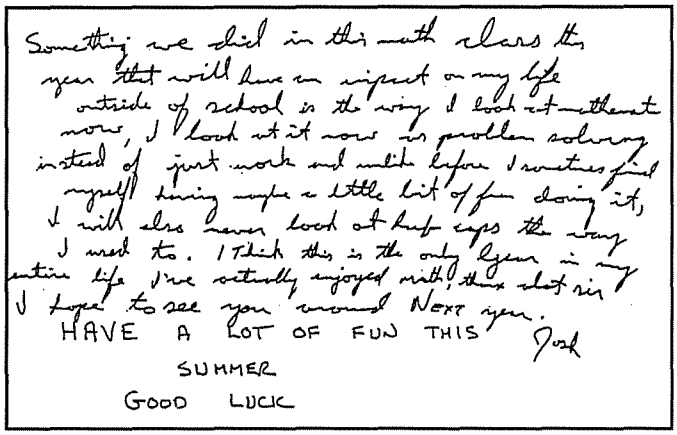
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We found out what kinds of balls if there was a million could fit in our classroom. If there are a million tiles, pencils, or paper in the school. How long it would take to run 1 million laps around the gym.

I learned that a million is actually a very large number, I thought that it was actually smaller, but when we did the investigations it would take a long time to do certain things 1000000 times.

I wonder what a million dollars actually looks like.

Figure 8: Grade 7 self evaluation on the concept of a million



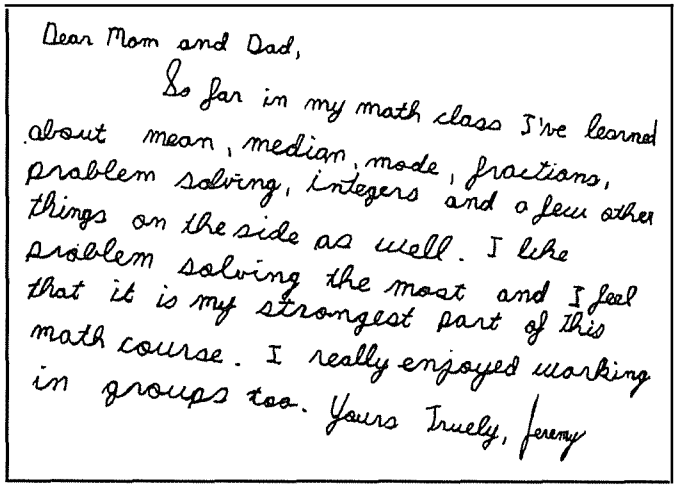
Something we did in this math class this year that will have an impact on my life outside of school is the way I look at things now, I look at it more in problem solving instead of just work and while before I sometimes find myself having only a little bit of fun doing it, I will also never look at things the way I used to. I think this is the only class in my entire life I've actually enjoyed with the whole thing. I hope to see you around Next year.

HAVE A LOT OF FUN THIS SUMMER

GOOD LUCK

Josh

Figure 9: Grade 8 peer evaluation on hubcaps



Dear Mom and Dad,

So far in my math class I've learned about mean, median, mode, fractions, problem solving, integers and a few other things on the side as well. I like problem solving the most and I feel that it is my strongest part of this math course. I really enjoyed working in groups too. Yours Truely, Jeremy

Figure 10: Grade 9 self evaluation on environments

Reflections act as an assessment tool by identifying what learning has taken place. This information allows teachers to make curricular and instructional decisions.

Conclusion

Students at the 7, 8, and 9 level demonstrated that stories and mathematical environments support an inquiry view of mathematics.

The following is an excerpt from an interview with a grade 9 student who had failed the previous year and moved to a class where the teacher used inquiry and mathematical environments.

Teacher: How have you found the tests and the way that the class was conducted this year?

Student: I like them better than last year. I just found it easier the way we study and the way that we do the work. It is different than last year. They just go on and on. This year we did different things but we still had to do math. Like the hubcaps. Last year I was told to draw a shape and that was that.

Teacher: The hubcap math was pretty interesting. I find myself looking at hubcaps differently. Do you find yourself doing that?

Student: Whenever I see a car go by.

Teacher: Do you think the activities helped you remember some of the concepts that you didn't understand the year before?

Student: Yeah. Because this year we learned that math is everywhere. Last year I was told that math is math no matter how you look at it, it was still math. This year I am looking at it differently. I can figure it out easier.

Students like the one above appear to remember what they learned when mathematics had context, purpose, and meaning. The examples presented in this article demonstrate the power of using stories and inquiry in the teaching of mathematics through environments and acknowledge many of the skills embedded in this approach. Students who explored hubcaps had to use their knowledge about measurement, angles, and computation. They had to observe and study hubcaps to find and locate their symmetrical attributes while working collaboratively with their peers. By reflecting on the process students discovered how much they had learned through their inquiries.

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TEACHING IDEAS FROM THE EDITOR

Calculus: a Helpful Mnemonic for Some Optimization Problems

DLEEC

D = Draw a Diagram

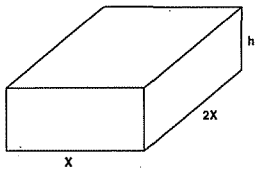
L = Let - define the variables in the diagram e.g. Let x represent the length

E = Express what is wanted in terms of the Let variables

E = Eliminate all but one of the Let variables in E above using information not applied as yet.

C = Use Calculus to solve the problem

Example A rectangular box with an open top is to be constructed from 96 cm^2 of material so that its length is twice its width. Find the dimensions of the box that will have the maximum volume.



D: Draw a rectangular box .

L: Let x cm represent the width of the box.

E: Express the wanted quantity, namely the Volume V cm^3 in terms of x and h.

V = length X width X height

Thus, $V = (2x)(x)(h) = 2x^2h$

E: Eliminate the variable h (because x is squared) using the fact that the area of the box is 96 cm^2.

Area of box = area of bottom + area of sides

$$\text{Thus } 96 = (x)(2x) + xh + xh + 2xh + 2xh$$

$$\text{or } 96 = 2x^2 + 6xh$$

$$\text{Solving for h gives } h = \frac{96 - 2x^2}{6x}$$

$$\text{Thus, } V = 2x^2\,\frac{96 - 2x^2}{6x}$$

$$\text{or } V = \frac{1}{3}(96x - 2x^3)$$

C: Use Calculus to solve the problem.

$$\text{For a maximum } \frac{dy}{dx} = 0 \text{ and } \frac{d^2y}{dx^2} < 0$$

$$\text{But } \frac{dy}{dx} = \frac{1}{3}(96 - 6x^2) \text{ and } \frac{d^2y}{dx^2} = -4x$$

Which will be negative since x, a length, is positive.

Hence V has a maximum which occurs for

$$\frac{dy}{dx} = 0$$

$$\text{or } \frac{1}{3}(96 - 6x^2) = 0$$

$$\text{or } x = \pm 4 \text{ (Omit } -4 \text{ since lengths are positive.)}$$

$$\text{and } h = \frac{96 - 2x^2}{6x} = \frac{96 - 2(4)^2}{6(4)} = 2\frac{2}{3}$$

Hence the box has a maximum volumn when the dimensions are length 4 cm, width 8 cm and height $2\frac{2}{3}$ cm.

1998 OAME Award Winners

Mona MacGregor Award
Peter C. Rose

Peter C. Rose is managing partner of FPR Corporate Communications & Public Affairs Ltd., a Toronto-based communications firm serving the financial and advanced technology manufacturing sectors. He has held this post since 1996.

Mr. Rose has twenty-three years experience in corporate communications and public affairs. One of his primary interests is fostering positive working relationships between educators (all levels and disciplines) and the business community. In 1995, he arranged the sponsorship of the OAME's Ontario Mathematics Olympics (OMO) by Rockwell International of Canada. In 1997-98, Mr. Rose coordinated a fund raising campaign to provide further financial support for the OMO.

Mr. Rose began his career with Goodyear Canada Inc. in 1975 as a staff writer for company publications. He held a variety of positions at Goodyear before being made that company's Director of Public Relations in 1985. He left Goodyear to join FPR as an equity partner in 1990.

Mr. Rose graduated from Sir Wilfrid Laurier University in Waterloo, Ontario, with a Bachelor of Arts degree in Political Science in 1974. He also holds a Journalism Diploma from Centennial College of Applied Arts and Technology in Toronto.

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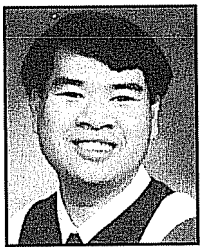
The members of the Barrie North Mathematics department are very appreciative of the honour given to us by OAME/OAEM in the awarding of the Kenneth D. Fryer Award. We enjoy working together not only in our school but also in the wider community of teachers of mathematics.

For many years we have had a major focus in each of our mathematics courses on problem solving, efficient use of technology and communication. More recently, additional emphasis has been put on integrated studies. Cross-curriculum integration has been a part of mathematics for many years so we have concentrated more on integration within the curriculum. This has been accomplished partially by the use of themes such as graphing and patterning. The use of these themes along with problem solving has enabled us to make connections among the topics that are part of each course.



A couple of our favourite department activities are the Matholympics for grade 7 and 8 students and an annual softball game between the teachers in the mathematics department and the OAC Algebra students. This year is our twenty-first annual Matholympics. A highlight for us in June of 1997 was helping to run the Ontario Mathematics Olympics.

DIRECTORS' DIALOGUE



LOUIS LIM

INTRODUCTION

I would like to thank Peter Saarimaki for allowing me to take over his *Director's Dialogue* column as he begins his term as OAME President-Elect. Peter has set very high standards, and I will do my very best to share with OAME members highlights of our council meetings. Wish me luck, Peter!

My name is Louis Lim, and I am a third year teacher at Quinte S.S. in Belleville. My first year of teaching will forever be cherished. I had the privilege of working and learning from Ron Lancaster. He taught me how to see the world mathematically, and selflessly introduced me to many of his math colleagues. He gave me the confidence to be innovative, and never doubted my potential.

I consider myself very fortunate to have been on the OAME board during my first year of teaching. OAME has provided me with numerous opportunities to professionally develop and network, and I hope that this column will allow me to give something back to the association. Without further adieu, I begin my first summary of the OAME council meeting held on Saturday, June 13, 1998 at Four Points Hotel in Mississauga. I'm eager to find out how I did ... e-mail me with your thoughts at: Louis_Lim@edu.yorku.ca.

WHAT GOES ON AT COUNCIL MEETINGS

Friday night was spent in a chapter representatives meeting to discuss our responsibilities and develop a network system with members. I'm using e-mail with a long list to keep in contact with ISOMA members. Other chapters use fax and contact department heads.

A significant amount of time was spent working in our assigned committees. Last year I was on the Publications committee and learned a lot about publishing the *Gazette* and maintaining the OAME web site. This year, I'm on the Transition Years committee, and instead of ending our meeting at 9:30 p.m., we went to 10:15 (on a Friday night!!).

President Ralph Connelly welcomed the new chapter reps to council: Elizabeth Pattison (GOLDEN), Carroll Lemon (NOMA), Wayne Fletcher (NWOAME), Kirsten Boucher (SAME), Anne Cirillo (TE^2Y^2MS), and Karen Hunter (Y^4MA). The newly elected directors were also welcomed: Stewart Craven, Jan Scully, and Jack Weiner.

Time was spent on budget, and we learned that membership continues to decline. With 1268 members as of June 1, 1998, that figure is down by 157 from last year. Please contact any council member on how OAME can best meet your needs.

Several council members were honoured for exemplary work: Mary Howe (for editing and organizing the new technology document presently on sale (see ad elsewhere in *Gazette*), Barry Scully (for his instrumental work in producing the "Scope and Sequence" posters for grades 6 to 8 teachers), and Myrna Ingalls (for her work with the specialization years).

Below is a summary of the committee meetings, along with the awesome professional development in the chapters. We have much to celebrate as OAME members, and I hope we can all share with our non-OAME colleagues the benefits of joining.

COMMITTEES

AWARDS

Congratulations to the following OAME award winners: Mary Loo Kestell (Life Membership), Anne Muller (Morley MacGregor Award), John Savage (Don Attridge Award), Peter Rose (Mona MacGregor Award), and the Mathematics department of Barrie North Collegiate, under the headship of Bill Morrison. Nominations for any OAME awards are accepted throughout the year. Look for the nomination form in the Gazette or contact Dave Zimmer for full details.

Also, congratulations to Ron Lancaster who won his third Hilroy Award. And last, but not least, congrats are in order for our past president, Judy Crompton, recipient of a Prime Minister's Award.

PUBLICATIONS

Check out the frequently updated OAME web site at www.mathstat.uoguelph.ca/oame. You will find information on upcoming conferences, chapter rep contact, chapter web pages, issues in Mathematics education, and some valuable links related to Mathematics education.

Both this issue and the December issue of the *Gazette* are packed with submissions to the *Abacus*.

OAME/AOEM Awards Nomination Process

Deadlines

Nominations for awards to be presented at the Annual Conference must be received by January 31 of the calendar year in which the conference takes place.

Nominations received after January 31 will be considered for awards to be presented during the next three calendar years. A nomination will be allowed to stand for three consecutive years. After that time, the nomination must be renewed. A standing nomination may be amended at any time by the original nominator. The nominator need only inform the chair of the Awards Committee in writing of the proposed changes to the nomination form.

The OAME/AOEM Nomination Form

Write a letter supporting the nomination of your candidate for the indicated award. Provide specific and detailed information about the nominee's activities as they relate to the following areas of consideration;

- demonstrations of excellence and creativity in mathematics education.
- specific contributions to mathematics education in the school, region, province or nation.
- demonstrates leadership in mathematics education in the school, region, province or nation.
- support of and contribution to the activities of OAME/AOEM.
- contribution to the development of students both within and outside of the classroom.

Please include any additional information that you feel may be relevant to the nomination, but which may not be specifically mentioned above.

The Nomination Cover Page

Complete the Nomination Cover Page and attach it to your letter of recommendation for the nominee.

Incomplete or inaccurate information may cause a nomination to be withheld form consideration.

OAME/AOEM LIFE MEMBERSHIP AWARD

The Life Membership Award is given to recognize a person who has contributed in a significant way to OAME/AOEM; demonstrated outstanding leadership in mathematics education; and accumulated 10 or more years of membership in OAME/AOEM.

KENNETH D. FRYER AWARD

In Memory of the late Kenneth D. Fryer, OAME/AOEM, in conjunction with the Grand Valley Mathematics Association, established the Kenneth D. Fryer Award. The award is to be given annually to recognize a mathematics department which fosters collegiality, team work, and excellent classroom teaching; contributes to the overall development of students; and demonstrates leadership in the mathematics education community.

MONA MACGREGOR AWARD

In recognition of the contributions made by Mona MacGregor, former OAME/AOEM Co-Secretary-Treasurer, OAME/AOEM established the Mona MacGregor Award. This is to recognize an individual who has made significant contribution to OAME/AOEM, but who is not necessarily an educator or a member of OAME/AOEM.

MORLEY MACGREGOR AWARD

In Memory of the late Morley MacGregor, former OAME/AOEM Secretary-Treasurer, OAME/AOEM established the Morley MacGregor Award. The award is to be given annually to recognize an elementary teacher who has demonstrated excellence in mathematics education, as well as contributing to the overall development of students beyond classroom activities.

DON ATTRIDGE AWARD

In recognition of the contributions made by Don Attridge, a founding member, former president and the previous Executive Director of OAME/AOEM, OAME/AOEM established the Don Attridge Award in the spring of 1995. The award is presented annually to recognize an exceptional and creative secondary school mathematics teacher who enhances the teaching of mathematics in Ontario.

AWARD NOMINATION COVER PAGE

Send to: Peter Saarimaki

Intended Award (please check one)

❑ Life Membership ❑ Mona MacGregor ❑ Morley MacGregor ❑ Kenneth D. Fryer ❑ Don Attridge

Nominee Information:

_____

Nome of Nominee (Principal and Department Head for K.D. Fryer Award)

_____

_____

School, Organization or Business Address

Telephone Number ( ) _____

Fox Number ( ) _____

Home Address _____

_____

Home Phone ( ) _____

Nominator Information:

_____

Nome of Nominator

_____

_____

School, Organization or Business Address

Telephone Number ( ) _____

Fox Number ( ) _____

Home Address _____

_____

Home Phone ( ) _____

That is a direct result of the hard work of *Abacus* editor, Frances Schatz, who visited local schools and wrote to out-of-town schools, as well as being seen at conferences.

Check out the advertisements in this issue of the *Gazette*! When purchasing products, be sure to mention that you saw the ad in the *Gazette.*

PROMOTIONS

The faculties of education continue to be targeted with visits and information packages to introduce future teachers to the benefits of becoming an OAME member. As a young teacher (although I feel like 70 some days!), I believe that OAME continues to provide me with the professional development and contacts I need as I strive to be an exemplary teacher.

The Promotions Committee also developed a "Promotional Kit" for chapters to use (e.g. during a mini-conference). Dave Alexander caught me off guard last year when he had to explain to me what was the Promotional Kit. At the council meeting I got to see it and was I impressed! Included are the OAME banner, pamphlets outlining the purpose of OAME, recent issues of the Gazette and Abacus, and publications for sale. Look for the Promotional Kit at your next chapter conference!

FUTURES

The Futures Committee confirmed the following:

- OAME 1999: hosted by Y^4MA in Richmond Hill;
- OAME 2000: hosted by COMA in Ottawa;
- OMO 1999: hosted by TE^2Y^2MS in Toronto;
- OMO 2000: hosted by QSLMA in Kingston.

The OMO guidelines continue to be revised. Each chapter will be sent activities which parallel the actual event (they could be used to prepare or actually used for their chapter Olympics). Also, one event will require the use of technology. The materials required (e.g. graphic calculators) will be clearly stated.

MATHEMATICS EQUITY

After the informative and interesting talk by Marcia Cunningham at the Equity Breakfast at OAME '98, plans are underway to recruit a speaker for OAME '99. Plan to enjoy breakfast while hearing a motivational speaker!

Anne Pedersen expressed concerns about the make-up of the OAME council. Of our 44 members, 34 are high school teachers, 6 members work with students over 18 years old, while only 4 members represent the elementary panel. The Equity committee is looking for ways to increase the number of elementary level teachers to the board.

EARLY/FORMATIVE YEARS

The Early/Formative Years committee is very pleased with the number of articles being submitted to the *Abacus.* In addition to lesson ideas, articles of interest to elementary teachers are being sought for publication in the *Gazette* and *Abacus*.

An area of concern addressed by this committee was teaching data management. Board member, Anne Pedersen, is producing an article for the *Abacus* demonstrating how to design a survey, along with a lesson or two. The committee is also looking into ways that "E-stat" (web site at www.statcan.ca) can be used to help elementary teachers implement meaningful learning experiences with data management.

TRANSITION YEARS

The Transition Years committee has developed a set of 5 posters, "**Scope and Sequence**", (for only $10.00!) to support grades 6 to 8 teachers implement the new math curriculum. The committee addressed the gaps found within and among the strands by adding additional expectations in italics and boldfaced. The organization of student expectations will help teachers plan their programs in relation with the new provincial report card.

For the upcoming year, the Transition Years committee will focus on using the posters to develop activities of inquiry, address the strands simultaneously, incorporate assessment, and assist teachers in the planning process.

SPECIALIZATION YEARS

The Specialization Years committee has developed "**Teaching Mathematics Through Technology**", a collection of classroom tested activities using computer software and graphic calculators. Included are 2 disks which allows you to edit the black line masters to suit your own personal style or classroom needs. See the ad in the *Gazette* for details!

A major focus in their committee meetings will be taking a topic from the secondary curriculum (e.g. quadratic equations) and developing a unit profile to envision it in the new curriculum using rich learning tasks. Their goal is to have teachers field test the material in February and reflect on the learning process of their students.

RESOURCE SHARING

Ontario Association for Mathematics Educators

Scope and Sequence Posters

Mathematics Grades 6, 7, 8

Large Attractive Posters (Red & Black)
Presents Expectations in
The Ontario Curriculum Grades 1-8 Mathematics 1997

By Strand:

- Number Sense and Numeration
- Measurement
- Geometry and Spatial Sense
- Patterning and Algebra
- Data Management and Probability

and by Category of Knowledge/Skills:

- Problem Solving
- Understanding of Concepts
- Application of Mathematical Procedures
- Communication of Required Knowledge

A Resource for: Planning, Assessment, Communication

One set of 5 Posters (41 cm x 63 cm)
$10/set
Mailing or delivery costs extra.

Order by mail or fax:
OAME

Do not send cash or cheque. You will be invoiced with shipping costs added.

One of the highlights of each board meeting is receiving a package of resources from John Kersley. John lugged 7 huge boxes of resources, and he left with only 2 boxes! I was able to pick up 3 extra copies of "***The Endangered Species Activity Book***" suitable for grades 7 to 9. So, if you're a middle school teacher, e-mail me, and I will send you a copy (I love e-mail!). Last I saw, these books were selling for $17.95!

John also distributed many newspaper clippings. Some pertain to the internet, a bundle of cartoons, and some interesting educational readings. Check out the web site **http://www.mathpro.com/mathCenter.html** for a collection of Math internet sites. Next time you're on the golf course, shout, "Square root of 16"! (get it??). Also included was the "***Mathville Assessment Library for Number Sense***" volume 1.0 for Macintosh and Windows. Contact your chapter rep to have a peek at the goodies John selflessly distributed.

NCTM

Remember that ordering NCTM resources through our rep, Frances Schatz, generates 20% of the sales to OAME. Also, new and renewed NCTM memberships also generate income to support Mathematics education in Ontario — $5 U.S. (is the exchange rate still 40%+ these days??).

Marg Warren suggested to council that members read "***The Open-Ended Approach: A New Proposal for Teaching Mathematics***". This Japanese model promotes high order thinking through the use of rich learning tasks.

PROFESSIONAL DEVELOPMENT

OAME'98

The 25th annual OAME conference was held in North Bay from **May 20 to 23**. 662 educators benefited from the many quality sessions and keynotes (Ivars Peterson, Ron Lancaster, and Georg Gunther). Unfortunately, Theoni Pappas could not join us as she was recovering from a heart attack. She sent her regrets by shipping 700 copies of her elementary and secondary level calendars (have you displayed yours in your classroom?). Pappas has stated an interest in attending OAME'99. Congratulations to co-chairs Shawn Godin and Susan Stuart and their many committees who worked endless hours to ensure the conference ran smoothly.

OAME'99

Mark **May 6 to 8, 1999** on your calendar! Y^4MA will host the 26th annual OAME conference in Richmond Hill. The theme is "Mathematics: New Visions — No Limits", and an impressive line-up of keynotes have been scheduled: Kay Toliver, Phoebe Gilman, Don Fraser, Marion Small, and Skid Crease. Get those P.D. funds early, and plan to attend! Co-chairs Jan Scully and Ann Rubin and their many committees are working around the clock to outmatch their awesome 1992 annual conference.

LEADERSHIP'98

This ever popular conference is slated for **February 25 to 27, 1999** in Mississauga. The focus for the secondary level will be professional development on the new curriculum, while the primary years will be based on the new Primary Years Assessment document (to be published in early 1999).

As many will know from last year, spaces are limited, and sell out very quickly. The reason why extra delegates are not allowed stems from maintaining a small working group. From what colleagues tell me, the price is very affordable (2 nights accommodation, meals, banquet, receptions, publishers' display, on top of the amazing networking and P.D. emphasizing "how to"). For further information, contact Bonnie or Dave Alexander.

CHAPTER NEWS

Below are highlights of chapter reports submitted by chapter reps. to OAME. Did you know that you can attend any chapter's mini-conference? Contact the respective chapter rep. for further information.

CHAMP

Mathfest'98, their annual fall conference, will be held on Thursday, November 5. Participants will benefit from two workshops, publishers' displays, dinner and an after dinner speaker. The CHAMP Mathematics contests are scheduled for November 18 (grades 9 to 11) and November 19 (grades 7 and 8). A whopping 32 page newsletter was distributed to members in June under the direction of Marlene Dewey!

COMA

A number of activities are planned for the new school year. COMA continues to prepare for OAME'2000 in Ottawa, their annual January conference, Mathematics Olympics, summer TI institutes, and curriculum seminars, to assist their members with the latest in curriculum developments.

GOLDEN

Their annual spring conference, held on April 22, 1998 at Brock University was a success with over 120 participants focussing on rich learning tasks. Their annual meeting is set for mid-September to set priorities for the upcoming year.

ISOMA

Holy Trinity School organized and hosted a very successful Math Olympics on May 8, 1998. Plans are underway for ISOMA's annual fall conference in October. Once again, participants will benefit from a keynote speaker, two one hour sessions, dinner, and door prizes. Contact me for the latest details!

MAC^2

A very successful spring mini-conference was held on April 15 in Orillia. An excellent turnout of elementary and secondary teachers were entertained and informed by Trevor Brown. April 23 saw the 21st annual Barrie North Math Olympics, and on April 30, the second annual Bracebridge and Muskoka Lakes Math Olympics. Their fall conference will be held on October 22, and repeated on October 29 and November 5. The focus will be helping elementary teachers implement the new grades 1 to 8 Math curriculum, with sessions specifically geared to K-4 and 5-8 teachers.

NOMA

NOMA was very pleased to host the 1998 OAME conference in North Bay. NOMA will be hosting several one topic workshops throughout the upcoming 98/99 school year. Keep in touch with the chapter rep for further details!

NWOAME

NWOAME ran its third regional Mathematics event, with over 160 grade 7 and 8 students! June 5 was the day NWOAME held its annual "Lakehead Mathematics Award Luncheon and Problem Solving Session" with over 150 secondary students participating in the event. The Rendez-vous MST conference will be held in the fall in Thunder Bay. Contact chapter rep, Wayne Fletcher, for further information.

QSLMA

A spring conference was held on April 16 in Kingston. Over 50 members attended to hear Judy Crompton, Mary Lou Kestell, and Roy Evans. QSLMA is busy preparing to host the OMO in 2000. E-mail chapter rep Gord Cooke for details on their upcoming fall conference.

SAME

A February 1998 conference, E=MC^2, was held to replace their fall mini-conference due to the political protest. President Alan Chan conducted a comprehensive needs analysis survey of SAME members, and plans are underway to host a fall conference in late October, a spring conference in April, and set-up an active bulletin board site.

TE^{2}Y^{2}MS

After hosting the very successful OAME'97 in Toronto, plans are underway to host the 1999 OMO at York University. Stewart Craven and Brian McCudden are the co-chairs, with many subcommittees organized. By now, TE^{2}Y^{2}MS members should have received their chapter newsletter. Contact the chapter rep. for details on their fall conference.

Y^{4}MA

"So, What's New", their 11th annual fall conference, is set for Tuesday October 6 in Richmond Hill. Participants will benefit from two one hour workshops, publishers' display, dinner, keynote, and door prizes. Look out for the first edition of their bi-annual newsletter soon. This busy chapter held three separate board competitions with 30-32 teams each! The top three teams from each board met at York University on June 6. Furthermore, co-chairs Jan Scully and Ann Rubin continue to prepare for OAME'99.

FINAL REMARKS

I hope you enjoyed reading my *Director's Dialogue.* Remember to e-mail me on how I did! Here's to a great school year! I look forward to meeting you at OAME'99!!!

Descartes Medal Award Winners

Congratulations to our *Gazette* advertising manager **Dean Murray** who was awarded a Descartes Medal last June by the University of Waterloo. Congratulations also to OAME member **Ron Bender** and to **Vicki Dale** who received a Descartes Medal at the same time.

OAME 1998-1999 Board

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Judy Crompton

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MAC^2 - Bill Morrison

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NWOAME - Wayne Fletcher

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SWOAME - Frank Di Pietro

TE^{2}Y^{2}MS - Kothy Kubota-Zarivnij

WOMA - Mary Howe

Y^{4}MA - Karen Hunter

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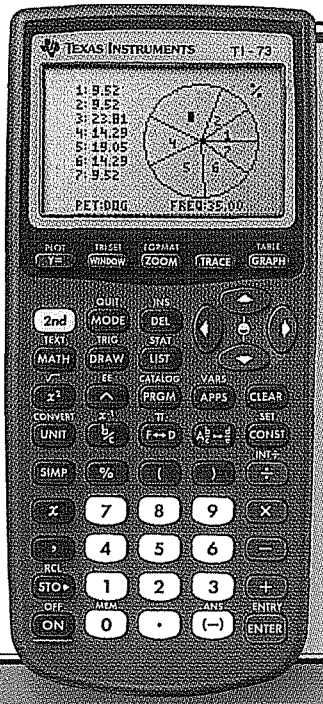
Jan Scully

Emilia Veltri

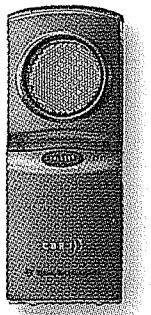
Jack Weiner

NCTM REPRESENTATIVE
Frances Schatz

WEB SITE COORDINATOR
Doug Evans



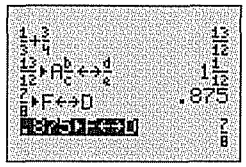
That's why we developed the new TI-73 with Graph Explorer Software, the first graphing calculator designed specifically for the middle grades. With the new, large-screen TI-73, students can plot pictographs, view bar graphs and pie charts, and even analyze real-world math and science data thanks to its integrated CBR™/CBL™ application. What's more, because of Flash technology, the TI-73 can be upgraded



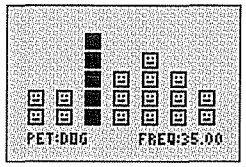
CBR application for real-world data collection like time, distance and velocity.

THEY UNDERSTAND MORE WHEN THEY GET THE BIG PICTURE.

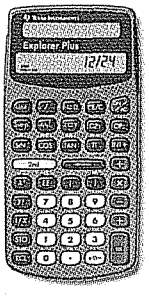
to meet changing needs in your curriculum. It's just the latest example of how we listen to your middle grades needs, then respond with products and programs that best meet those needs. In fact, we cover the middle grades from top to bottom. By the way, the TI-73 shares familiar functions with our popular Math Explorer™ and Explorer Plus™. So now you can choose from a whole range of calculators for different ages and abilities. Get the picture?



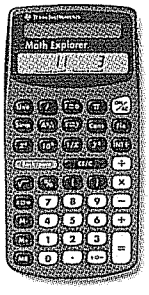
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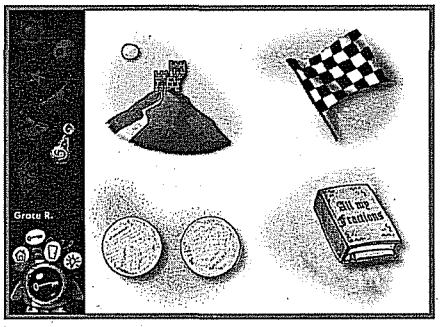
A STILL CANADIAN gage After All These Years Since 1844

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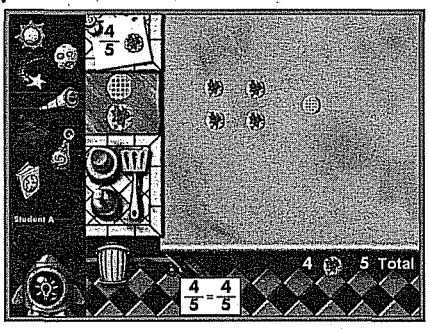
FRACTIONS

BRAND NEW HYBRID CDs!



Fraction Operations *Grades 4-6*

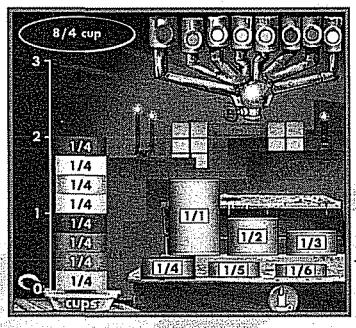
Students build on the concepts of fraction meaning and equivalence as they operate with fractions. Students see the purpose of constructing same size parts when they add and subtract using various models of fractions, and gain informal experience multiplying fractions when they create an area model to find a fraction of a fraction. They use measuring tools to explore division with fractions.



Equivalent Fractions *Grades 3-4*

Through experiences with concrete objects and with diagrams, students compare amounts to determine equivalence. When students have a solid understanding of equivalence, they can mentally create equivalent fractions without the use of objects or diagrams, and can eventually use their understanding of fractions and equivalence to create ways to add, subtract, multiply, and divide fractions in real-world situations.

Call about new pricing on CDs



Representing Fractions *Grades 4-6*

Students work with one interpretation of a fraction, namely as a relationship between parts and wholes. Students develop their understanding of fractions as parts and wholes through symbolic representations. The activities give students the ability to divide a whole into equal parts in several different ways, use fraction names to identify equal parts such as fourths, prove that parts are equal, and create representations of fractions.

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