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The *Ontario Mathematics Gazette*—ISSN 0030–3211—is indexed in the Canadian Education Index and is published four times per year. Its Canadian Publication Mail Product Sales Agreement Number is 40051074.

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▲ Editor's Message



MARILYN HURRELL, EDITOR

McLean's magazine (September 22 2003) arrived about the time I was preparing this issue of the *Gazette*. The cover showed two smiling children and highlighted an article called "The ABC's of Classroom FUN". I read the article with interest, because the writer singled out the teaching and learning of mathematics on almost every page. The opening paragraph told of a classroom in Calgary where grade 4 students were tackling the 6-times table. One child burst out that he "hated the times table" and "the teacher made these up to torture us". Not many of us have ever had a folk singer standing nearby in the classroom, but this lucky teacher did, and the folk singer immediately engaged the children in a song about the 6-times table. The strong message was that math, combined with music, drawing, hands-on activities and other alternative teaching strategies, fires up the students' interest in mathematics and reduces the fear of failure.

Coincidentally this issue of the *Gazette* features a article by OAME President Stewart Craven on the **Vision Project**, which members of the OAME Board and the teaching public, have been developing over the past two years, and which is now nearing completion. Statements such as, "Effective mathematics education requires strategies that engage and motivate learners, that help students develop positive attitudes about themselves and about mathematics, ..." are just one of the many facets of the Vision Project that address the concerns raised by the author of the *McLean's* article.

Also, this issue includes an article in which the author describes activities for young children (and adults!) which combine math, science and art, in the construction of sun catchers and kaleidoscopes. The companion *Book Review* by Laurie Moher, *Big Ideas for Small Mathematicians* offers 22 more ideas for activities in the mathematics classroom. The *Abacus*, as always, presents interesting hands on activities and cross-curricular projects.

We welcome back Jack Weiner to the Ontario Mathematics *Gazette*. Jack was *Gazette* Editor for several years and returns as a columnist. So, enjoy these and all the other fine ideas in your December 2003 *Gazette*.

Best wishes for a happy and relaxing holiday season. ▲

Marilyn Hurrell

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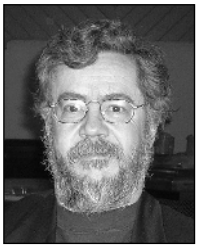
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▲ President's Message ~ Growing Up Geometrically



STEWART CRAVEN

Recently, I had the pleasure of taking a course entitled "Geometry for Teachers" with Margaret Sinclair and Walter Whitely. I found the first assignment to be very revealing, since our instructions were to write a "Geometry Autobiography". More specifically, we were challenged to describe our earliest recollections of Geometry as we had experienced it as students in grade school. We then traced our experiences through high school and university, until, at a certain point, our roles reversed to that of teacher. We even delved into how geometry fit into our lives outside of the classroom.

The following are excerpts from my own "Geometry Autobiography."

> *When and how does anyone experience Geometry for the first time? Does it occur when first observing the parallel lines that form the sides of your crib? Perhaps it occurs when you are given your first ball. Or maybe it's when you begin to analyze the shapes of the vegetables floating in your soup!*
>
> *What I do remember about my childhood was my fascination with building sets, such as wooden blocks, Tinker Toys, Meccano, Erecto, and Kenner Building Sets. I spent hours building great cities and industrial parks, and in the process, was, no doubt, subconsciously exploring transformations. In a more formal way, I remember learning some Euclidean proofs and a variety of constructions in school. However, Geometry was pretty much non-existent in the courses that I took at Queen's in the early 70's. This was not surprising, given that my first degree was in Politics and Economics. I later applied to FEUT to do Junior/Intermediate Mathematics. While most of the Geometry that I did seemed rather straightforward, I sensed that it was far more important for me to know and understand Analytical Geometry than Deductive*

Geometry.

The first Mathematics course that I taught was Grade 13 Algebra and Geometry. Despite my Intermediate qualifications, I was hooked on teaching high school. It seemed, however, that whenever Geometry was a part of the syllabus, the majority of students struggled with it. I did not know whether it was the difficulty in recognizing relationships or the difficulty with the logic of simple proofs that was the main roadblock to their understanding.

On my road to acquiring my Honours Specialist in Mathematics, I took the required courses from four different universities. As I recall, one Geometry course went this way:

Lemma, lemma, lemma, proof
Lemma, lemma, lemma, proof
Lemma, lemma, lemma, proof
Test
(repeat this refrain four more times)

Most assuredly, this approach was not transferable to the high school classroom.

I was fortunate that the majority of my teaching career took place at Marc Garneau Collegiate Institute where I taught a variety of courses at various grade levels. Fundamentally, I taught Geometry in a traditional manner. It was not until I left the classroom to become a consultant that Geometer's Sketchpad *was introduced as powerful tool to teach Geometry. The moment I first loaded it onto my computer, my personal exploration of geometry began. A number of teachers and consultants supported each other as we struggled with our explorations, while workshops, such as the one at Queen's a couple of years ago, acted as catalysts to redouble our efforts. I have since worked with many middle and high school students who use the* Sketchpad *to explore ideas.*

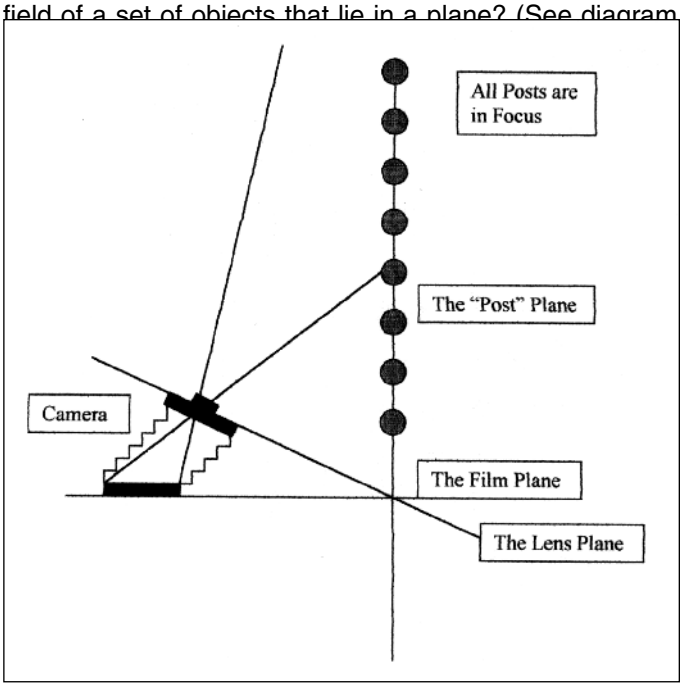
The use of Sketchpad *does shake up how one teaches. You must carefully define the learning goals and then consider what you do with the students before they enter the lab, how to facilitate when you are in the lab, and how to debrief once you leave the lab. Issues about assessment and evaluation and whether to use prefabricated sketches or not must be considered. David Pimm and Nick Jackiw, when presenting last year at CMESG, demonstrated a unique method of how one could teach using the* Sketchpad. *They challenged us to analyze someone else's sketch to try to make sense of their understanding. This provided deeper insight into how others think and demonstrated how one's understanding tends to be either divergent or convergent.*

In completing this assignment, my colleagues and I began to understand how our own learning and teaching evolved. I began to be able to consider questions such as, "Have our teaching approaches diverged from the way we were taught? Are our students more engaged than we were? Do today's students achieve more?"

This is an exercise that I recommend we all try. You could, of course, substitute the word Algebra, or more broadly, Mathematics, for the word Geometry.

P.S. We were encouraged to take ownership of our learning by posing a Geometry question of interest to us. This was my first question.

What is the Geometry behind the type of camera adjustment that allows you to have an infinite depth of field of a set of objects that lie in a plane? (See diagram



▲ Nominations for OAME/AOEM Board of Directors 2004-2005

Each year, elections are held for a President-Elect, a Vice President (3 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 23, 2004, to:

Margaret Warren, Past President

Include the nominee's qualifications with the Nominations Form. A nominee must be a member of OAME. By March 2004, 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 results will be released at the Annual General Meeting of the OAME/AOEM in Waterloo, April 2004.

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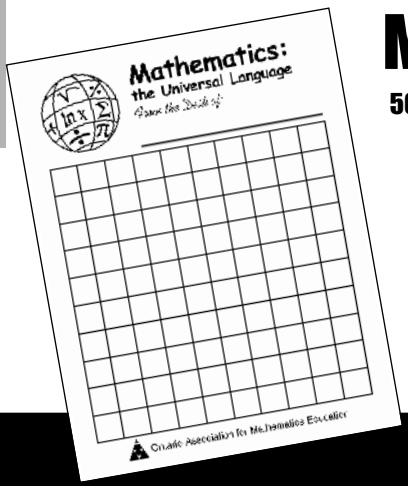
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▲ Letter to the Editor

Dear Editor,

We thank Ysbrand de Bryun for his article *Mathematics After Geometer's Sketchpad: Median Triangle Offspring, Gazette*, June 2003. It raises some important issues about rich learning tasks, and we wish to take this opportunity to clarify our own thinking about this and other rich learning tasks. What makes a learning task 'rich'? What can make it anaemic? What should authors of tasks ask / write? What should teachers do to animate / facilitate student engagement in a task? We think questions such as these are of critical importance to teaching and that they deserve on-going attention and discussion. As the authors of the examples that Ysbrand refers to in his article (see below), we would like to react to his comments and contribute to this discussion.

1. The Tasks Referred to in Ysbrand's Article

Investigation 1: A Triangle and its Median Triangle

1. Construct and label a triangle using The Geometer's Sketchpad. Also construct and label the three medians of the triangle.
2. Construct a second triangle, using the medians you constructed in #1 as its 3 sides.
3. Predict how these two triangles will compare. Check your predictions using Sketchpad tools.
4. How does your answer to the last question change if you start with a different triangle? Check by dragging the original triangle into different shapes. Write a report summarizing your findings, using words, pictures, and numbers.

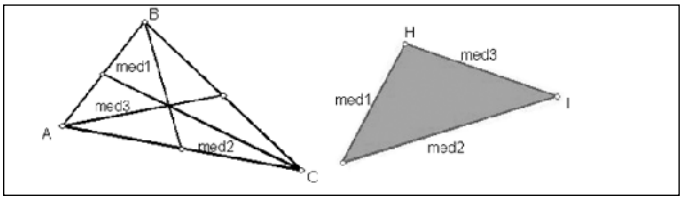


Figure 1. A Triangle and Its Median Offspring

Investigation 2: A Triangle and a Different Offspring Triangle

1. What other line segments could you have possibly used in this investigation instead of medians? Brainstorm some ideas.
2. Investigate one of the ideas you brainstormed. Write a report on your findings using words, pictures, and numbers.

2. Prompts for Mathematical Activity

Elaine Simmt (U. of Alberta) once said, "the teacher needs to provide students not problems to solve but with prompts for mathematical activity." Our first investigation was intended to introduce the student to the generative idea of a polygonal offspring and act as a prompt for further mathematical / sense-making activity on the topic. Prompts worth their salt should lead to curricularly relevant, student (as sense maker) relevant, and mathematically significant activity. Authors provide the (initial) prompt. Teachers and students provide the activity and subsequent prompts.

3. The Questions We Ask

In 'writing-up' an activity, many decisions must be made: Who asks the questions? When are the questions asked? What kinds of questions are asked? Ysbrand says, of Investigation 1, "There are two important questions that the students are not asked to consider in this investigation. *Why do the medians always form a triangle?* and *Why is the ratio of areas of a triangle and its median offspring invariant for all triangles?*" We didn't ask these questions in the belief that they weren't ours to ask. (We think that the richness of the task is, in part, dependent on our not asking these questions.) They are questions for students to ask. They are questions that should be asked but asked when it is appropriate to do so, as the investigation unfolds, and not before the student sees a need to ask them. Students should be given a chance to ask these questions (unprompted) and, failing that, teachers should prompt / encourage the asking of such questions.

The first investigation was intended to introduce students to the idea of 'offspring', to actually create a sample offspring, the median offspring of a triangle. It is not until students tackle the second investigation, where choices other than medians turn out to not always produce an offspring, that most students would be ready to consider the issue of existence and ask the question 'Does every parent triangle have a median offspring triangle?'. This is why many teachers would wait until this moment to revisit Investigation 1 (with teacher prompting if necessary) and 'deal' with the existence problem. For a Grade 9 student, dealing with the problem could mean dragging the original triangle into many positions, for a student in a later grade it could mean using one of the methods Ysbrand outlined in his article.

The richness of a task can be affected by the way in which students and their teacher engage the task. For example, the second part of Investigation 1 directs students to "Construct a second triangle, using the medians you constructed in #1 as its three sides." (Even though the Sketchmad web site provides one method for constructing the median offspring) many teachers would likely (and rightly) not require / expect the same method of

construction from all students. They would help students with their constructions (or let other students help) and encourage students to find alternate or even slicker methods. Teachers would also facilitate a sharing / evaluating of methods. The methods of offspring construction identified would likely include the one in which the offspring partially overlaps the parent and shares one of the parents medians [see figure 2.]

The second question *Why is the median offspring to parent ratio 0.75?* can be tackled in the first investigation. As authors, we didn't ask this 'why question' in the belief that students should have the opportunity to ask it and that teachers should have the opportunity to model / encourage its asking. Asking Why? is a critical part of sense making, and perhaps one of the most important habits of mind the teacher must try to develop in students. But the Why? question must originate in the observation of an interesting relationship or phenomenon. Even mathematicians first want to know *that* something is true before they move on to wondering *why* it is true. The student needs to experience this evolution of engagement with mathematics ideas and to develop an expectation that they will get an opportunity to confront the Why? question.

Selecting and dragging a point on the parent triangle (the construction shown below), allows the student to notice all sorts of properties and connections, including parallel lines, lots of bisections, and lots of equal-area'd triangles. Hopefully the students and teacher will be able to put enough of these things together to generate a convincing proof that the offspring always has 75% of the parent's area. Prompts such as, 'List things you notice when you drag a vertex of the parent triangle?' 'What evidence can you provide to support / refute that assertion?' 'Try to use some of these ideas to demonstrate that the offspring is $\frac{3}{4}$ the size of the parent.' should help animate / focus student and teacher action. We believe that this is preferable to presenting students with a list of 12 teacher-created instructions and questions that lead the student to a proof of the area conjecture (as Ysbrand suggests in his article.).

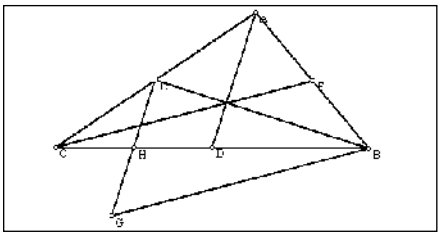


Figure 2. Constructing a Triangle and Its Median Offspring

4. Pseudo-rich Tasks

A task's potential richness can be negated by the way it is structured / designed. Giving students a recipe that leads them inexorably to the desired conclusion (through a carefully sequenced set of directions and questions) is characteristic of many 'guided-discovery activities' / pseudo-rich tasks one frequently sees in texts and other resources. They generate lots of activity but it is seldom sense making activity. Such activity generally results in students reaching appropriate conclusions about interesting situations, usually correctly and with minimal fuss and bother, but the activity doesn't give students the opportunity to try to (or learn how to) make sense of the situation themselves. It only gives them the opportunity to confirm that the teacher (or authors) can make sense of the situation and probably (mistakenly) confirm in their minds that they would never be able to come up with such ideas and conclusions themselves.

5. Our Challenge as Teachers and Authors

What we, as authors, say in the investigations and what we ask the students to do shouldn't be all that is said, all that is asked, or all that is done. But these additional things should come out as the investigation unfolds. These things should come out as the student interacts with the task, with other students, and with the teacher. As authors we make the assumption that a skilled and knowledgeable teacher is in the classroom, that the teacher knows when to prompt, what to prompt, how to prompt, when to be quiet, how to direct attention, how to animate students, how to encourage reflection, how to ensure productive interaction, when and how to clarify, how to conduct an inquiry, how to model sense-making behavior, ...

Ysbrand concludes his article by saying 'Care must be taken with how *Sketchpad* is used in the mathematics classroom so that it does provide new mathematics insights for the student, since after a student leaves school, few will ever use [*The*] *Geometer's Sketchpad* again.' To this we would add that insight into offsprings of polygons is not in itself important. Investigations into things like polygonal offsprings are important as vehicles for helping students to learn how to think mathematically, how to make conjectures, how to look for patterns and invariances, how to gain insights into phenomena, and how to develop understanding about who and why various relationships exist. In fact, *The Geometer's Sketchpad* reflects something integral about how good mathematics can be done.

It is very apparent to us that Ysbrand (when wearing his 'student of mathematics' hat) found the 'offspring task' a rich one. The challenge we face as teachers and authors is to ensure that it first and foremost becomes a task that proves to be rich for the student.

Gary Flewelling & Nathalie Sinclair ▲



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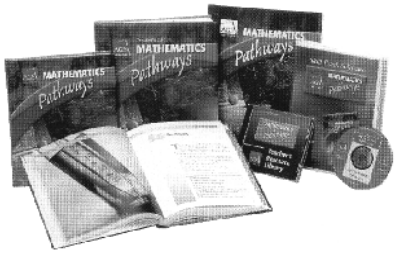
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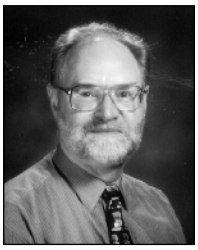
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▲ Technology Corner: Graph Data Bases and Piecewise Functions

FRED FERNEYHOUGH



Fred Ferneyhough is Head of Mathematics at Central Peel SS in Brampton and is technology consultant for the McGraw-Hill Ryerson texts in Ontario. He is an avid user of, and advocate for, the use of technology in the mathematics classroom.

A graph data base is a set of items stored in the memory of the calculator. You can save up to ten data bases in memory. Each one will store:

1. The graphing mode
2. The window values
3. All functions stored in the Y = editor
4. The style of each graph
5. The format settings

Let's say that you've put together a great lesson on transformations. You have all of the functions that you want to work with prepared and stored in the y = editor. Each function has its own style and you have the window set up just the way that you want it. Now, you go into class and you want your students to enter your functions, set the styles and copy your window. Oh, and you have three parts to your lesson (one for horizontal translations, a second for vertical translations and another for combinations). You have everything perfectly planned out and all that your students have to do is to follow your instructions. All goes well until you have them enter the first set of functions and graph them. If your classes are like mine, there will always be one student who just can't get what you have on your screen or cannot follow the directions that you are providing.

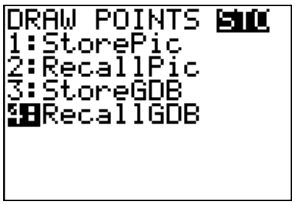
Here's a suggestion that you can use to get around these problems. Get everything set up just the way that you want it and store it in a Graph Data Base or GBD. Press DRAW (ψ and ?), move right twice (or left once) and choose option 3:StoreGDB.



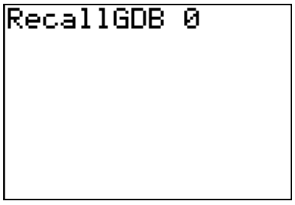
The command "StoreGDB" will be displayed on the home screen. Enter a number for your data base and press ENTER. You can use any number from 0 to 9.



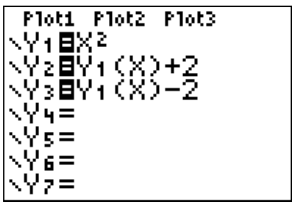
When you need to get the graph data base back, you simply choose the RecallGDB option from the same menu. This command will return all of the information that you stored in the graph data base.



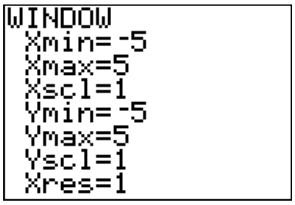
There are two drawbacks to this feature. First, it overwrites your window, and any functions that you may have been working on. Second, it requires that you transfer the graph data bases from your calculator to the student calculators. However, I have found that students become very adept at doing this.



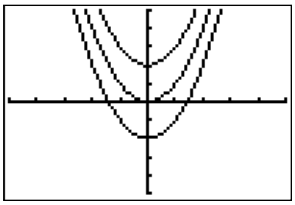
The quadratic function is commonly used as a base function for demonstrating transformations. To show how this works on the calculator, the screen to the right shows that $y = x^2$ has been stored in Y_1. The functions Y_2 and Y_3 have been defined in terms of Y_1 by adding or subtracting a constant.



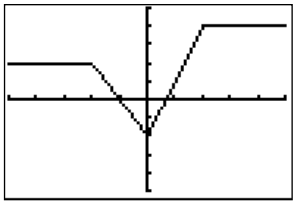
Try defining the window shown to the right and then graphing the set of functions.



Prior to using calculators, I used to draw these functions at the board, making each function look identical to the original. The calculator screen shows that my diagrams were not always accurate.

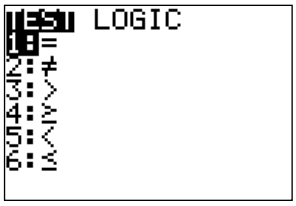


Using the calculators, I can design a new type of base function that better demonstrates the concepts that I am trying to get across. At the same time, I can reinforce some of the ideas of domain and introduce piecewise functions. My function has four pieces:

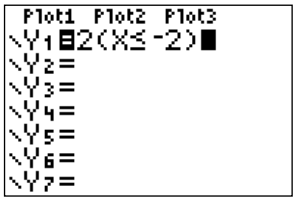


1. The horizontal function y = 2 on the domain x < -2
2. The linear function y = -2x – 2 on the domain -2 < x < 0
3. The linear function y = 3x – 2 on the domain 0 < x < 2
4. The horizontal function y = 4 on the domain x > 2

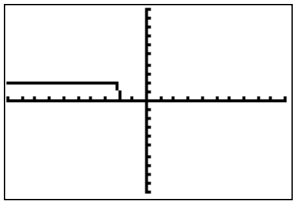
In order to use define the domain, we can use the logical operators found in the TEST menu by pressing the y and ? keys.



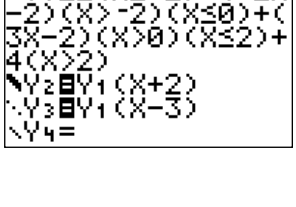
It is best to build the function one step at a time. To create the pieces, you need to define both the function and the domain that it is graphed on. This screen shows the function y = 2 and the domain x < -2. Think of this as a logical condition with an outcome of either 1 or 0. The two parts of the expression are factors that are being multiplied to give a y value at each point. Thus when the domain condition is satisfied the value of y will always be 2 and you should get a horizontal line segment for this piece of the function.



You get a bit of a surprise the first time that you graph this piece of the function. You can see that the horizontal line has been graphed from the left side up to x = -2, but then a jagged line appears from the end of the piece back to the x-axis. The reason for this is that the domain condition is no longer true and has a logical value of 0. So, to the right of x = -2, the device multiplies the expression by 0 and attempts to connect the last point on the line segment to the next point on the x-axis, causing the jagged edge.

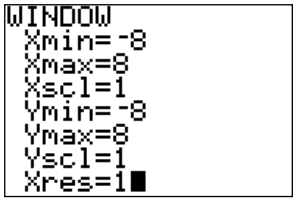


To connect the pieces of the function in the Y= editor, you use the addition symbol. The device cannot handle the compound inequality –2 < x < 0, so you define it in two parts. When both conditions are satisfied, each will have a logical value of 1 and we get a portion of the linear function y = -2x – 2 as the second piece.



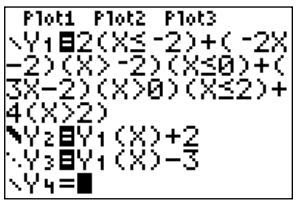
The screen to the right shows the two pieces programmed so far.

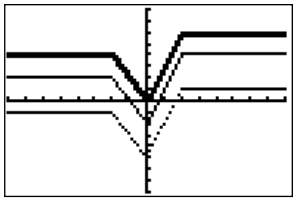
The process is continued until all four pieces are entered in Y_1 and we get the graph shown above.



Next, we need an appropriate window to work with, keeping in mind that we want to demonstrate several transformations.

In the first part of the lesson, we can add or subtract a constant to get a vertical translation. Notice that Y_2 and Y_3 are both defined in function notation in terms of Y_1, just as we attempted with the quadratic functions earlier. To the left of the function names, you can see that the styles of the new functions have been set to different thickness to allow us to see the differences on the graph easily.





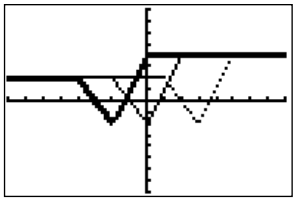
Unlike the example with the quadratic functions, the graph shows that the shape of the function remains the same.

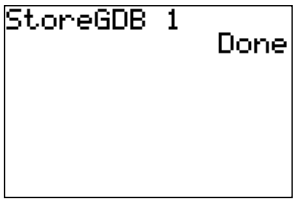
Now, that I have everything that I want for this portion of the lesson, I will save it as a graph data base. Students can experiment with the set of functions by changing the constants.



In the second portion of a transformation lesson, perhaps on a second day, we will look at horizontal transformations. Again, Y_2 and Y_3 are both defined in function notation in terms of Y_1.

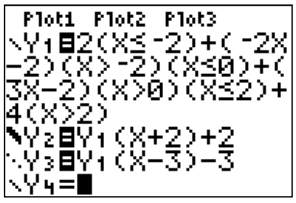
The graph shows the effects of the transformation. Using this approach allows the students to see the results of adding or subtracting a constant and coming up with the fact that the direction of the transformation is the opposite of what might have been expected.



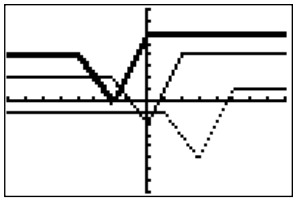


Once you have all of the details taken care of, save the new set of functions as a graph data base, using a different number than before.

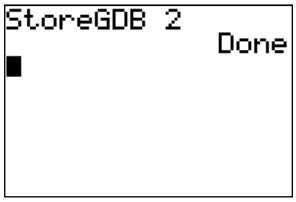
A final portion of this set of lessons should be a combination of vertical and horizontal translations. As before, Y2 and Y3 are both defined in function notation in terms of Y1.



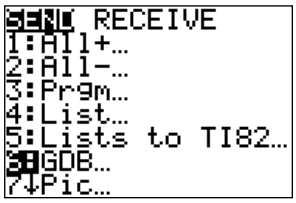
The graph shows that each of the new functions has been moved in two directions away from the original function.



Now that this is all in place, save this as a graph data base using a different number to identify the GDB.



Now, when you take your calculator in to your class, you need to set aside a few minutes to have your students transfer your graph data bases into their calculators. ▲



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GVMA IS HOSTING THE ANNUAL OAME CONFERENCE AT THE UNIVERSITY OF WATERLOO APRIL 29, 30 AND MAY 1, 2004. WATCH FOR DETAILS OR VISIT www.oame.on.ca

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, and
- 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 from 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 has 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.

AWARD FOR OUTSTANDING CONTRIBUTION TO OAME / AOEM AND MATHEMATICS IN ONTARIO

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.

AWARD FOR EXCEPTIONAL AND CREATIVE TEACHING IN ELEMENTARY MATHEMATICS

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.

AWARD FOR EXCEPTIONAL AND CREATIVE TEACHING IN SECONDARY MATHEMATICS

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

INTENDED AWARD *(please check one)*

- ❑ **Life Membership**
- ❑ **Kenneth D. Fryer**
- ❑ **Award for Outstanding Contribution to OAME / AOEM and Mathematics Education in Ontario**
- ❑ **Award for Exceptional and Creative Teaching in Elementary Mathematics**
- ❑ **Award for Exceptional and Creative Teaching in Secondary Mathematics**

Nominee's Information:

_____

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

_____

_____

School, Organization, or Business Address

Telephone Number ( ) _____

Fax Number ( ) _____

Home Address _____

_____

Home Phone ( ) _____

Nominator's Information:

_____

Name of Nominator

_____

_____

School, Organization, or Business Address

Telephone Number ( ) _____

Fax Number ( ) _____

Home Address _____

_____

Home Phone ( ) _____

SEND TO: Judy Dussiaume

▲ Photo Math – A new way of picturing math

RON LANCASTER
INDEPENDENT MATHEMATICS CONSULTANT



Ron Lancaster is a middle and high school mathematics teacher, currently working throughout North America and Asia as an Independent Mathematics Consultant.

"A picture is worth a thousand words" is an expression that is often used to convey the importance of using images to make a point. The point of this column is to go beyond this notion and promote the idea that in fact "A picture is worth a thousand numbers". Photos with Math is what readers can expect to find in every Photo Math column and the emphasis will be on seeing and doing mathematics everywhere. Teachers may want to assign these questions to their students as part of an overall effort to make connections between the curriculum and the world around us. Establishing these connections is at the heart of the new Ontario curriculum as well as the new NCTM document, *Principles and Standards for School Mathematics*. It is hoped that these questions will inspire students to be more creative and playful and that in the end, students will develop an ability to see the world from a different perspective.

Teachers and students are encouraged to pose mathematical questions related to their own encounters and to submit these problems along with photographs to the Author for possible publication in future columns. Photos can be sent via e-mail or by regular mail to the Author of this column.

Introductory comments for the December 2003 Column

The following photographs were taken at the Grounds For Sculpture in Hamilton, New Jersey during the summer of 2003. This outdoor sculpture gardens is in a magnificent setting about 20 minutes from Princeton. A huge collection of sculptures is spread out over 35 acres and the pieces of art are connected via wandering paths that meander through gardens, a lake, ponds and forested areas. Exhibits and shows are held on the grounds of the Grounds and inside the Museum Building. Visitors to the Grounds can dine at a wonderful restaurant called Rats that has become very popular. It is not unusual for people from Manhattan to drive almost two hours to have dinner at Rats! Information about the Grounds can be found at www.groundsforsculpture.org.

If you would like to visit the Grounds for Sculpture and combine the trip with some mathematics, I have a suggestion for you. Plan now to attend the 5th Annual Peddie School Mathematics and Technology Conference for Middle School Mathematics Teachers. The conference will be held August 8 - 12, 2004 at the Peddie School, located about an hour from Newark, New Jersey and about ten minutes from the Grounds for Sculpture! This is an outstanding professional development experience and I highly recommend it. For more information go to http://falconnet.peddie.org/mathconf ▲

▲ Upcoming Events

For further information, please contact the Chapter Representative (see last page of the *Gazette*) for OAME conferences, and Frances Schatz, OAME's NCTM Representative, for NCTM conferences.

OAME Conferences

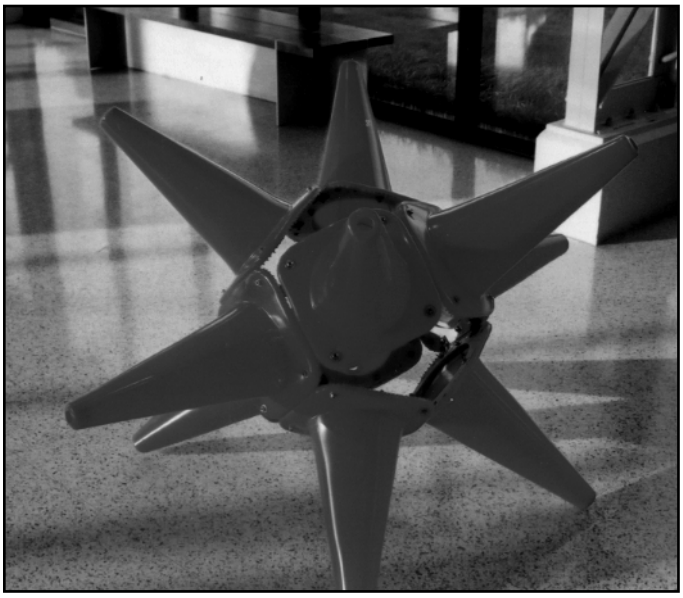
(Most Chapter Conferences are held out of school hours)

January, April 2004	Ottawa	COMA Forums
February 19 - 21 2004	Delta Toronto Airport West	OAME Leadership Conference
February 26 and 27 2004	Thunder Bay ON	NWOAME Chapter Conference
April 1 2004	TBA	WOMA Spring Conference
Early April 2004	Brock University	GOLDEN Spring Conference
April 28 - May 1 2004	University of Waterloo	31st OAME Annual Conference
June 18 and 19 2004	Durham College	OMO 2004 hosted by PRMA

NCTM Conferences

April 21 – 24, 2004	Philadelphia, Pennsylvania	82nd Annual Meeting
April 28 – May 1, 2004	University of Waterloo	31st Annual OAME Conference

Photograph #1



This sculpture was made from eight bright red traffic cones. The sculpture is fun to look at and it is very clever and creative.

For the purposes of this question, suppose that each cone has been identified with a unique number from 1 to 8.

(a) When the sculpture is set on the ground, there are three cones that touch the ground. How many ways are there of setting the sculpture on the ground?

(b) Is it possible to number the cones so that the three numbers on the cones that touch the ground, when read in a clockwise direction, always form a composite number?

Photograph #2



This large and tall metal sculpture has seven faces, two of them are trapezoids while the other five are rectangles. A ladder leaning against the sculpture is permanently attached to it.

(a) What measurements would you need to make in order to find the volume of this sculpture? What is the fewest number of measurements that would be needed?

(b) While it is not easy to see from looking at the picture, the ladder touches the top of the sculpture on the tenth rung of the ladder (counting from the ground). If you knew the distance between rungs on this ladder, what other single measurement could you make and then use to find the height of the sculpture?

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Photograph #3



Imagine that a second and bigger version of this sculpture sits beside the one shown in the photograph. In this second version, the top of the platform is still a square and the length of the side of this square is equal to the diameter of the sphere. If the diameter of the larger sphere is twice that of the smaller, compare

(a) the volume of the two spheres

(b) the surface area of the two spheres

(c) the radius of the two spheres

(d) the area of the two square tops

(e) the perimeter of the two square tops

Photograph #4



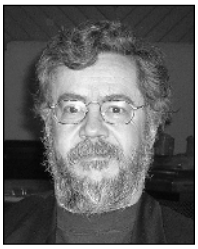
This metal sculpture on a stand shown in Photograph 4 makes use of a design that involves an equilateral triangle. Let's suppose that the artist started with an equilateral triangle made out of metal and then removed an equilateral triangle from the interior to make this sculpture.

(a) Without making any measurements, estimate the percentage of metal that was removed from the interior. Then make whatever measurements are necessary to determine exactly how much was removed. Compare this result to your estimate.

(b) Suppose that 80% of the metal was removed to make this sculpture. Prove or disprove that the length of the side of the small equilateral triangle is equal to 80% of the length of the side of the large equilateral triangle.

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▲ A Vision for Learning Mathematics



STEWART CRAVEN

In September's edition of the *Gazette*, I wrote passionately about the existence and the importance of "communities of learners" made up of mathematics students, teachers, and professors together with parents and citizens. For the past year and a half, I have been privileged to observe and participate in a learning community that is producing an outstanding set of resources.

The teachers who are developing various pieces of the *Vision Project* will, no doubt, be profoundly influenced by their participation. It is our hope that these resources will have a similar impact on all Ontario mathematics teachers, who will, in turn, motivate our young people to become life-long learners and numerate citizens.

Where do *Vision Projects* come from? We have all been students in many Mathematics classrooms. If we were asked to describe those Mathematics classrooms, we would likely be hard pressed to remember most of them. Quite often, the rooms were barren landscapes where chalk dust filled the air, desks were neatly arranged in rows, and the occasional metre stick or board compass sat in the corner. The stuff of Mathematics was bound between two covers, and in order to learn, our listening skills had to be carefully honed. This is not to say that our teachers were not knowledgeable or that they lacked the ability to motivate students. However, they worked at a time when educational research was not nearly as well documented as it is today. This meant that students whose learning styles were compatible with the predominant delivery method achieved success while the other students did not. The OAME *Vision Project* is based on our firm belief that **all students can learn Mathematics**.

The *Vision Project* consists of four main components:

1. the OAME foundation statement, "A Vision for Learning Mathematics"
2. learning activities
3. the OAME video illustrating the continuum of learning
4. professional development strategies

The OAME Foundation Statement, "A Vision for Learning Mathematics"

Probably nothing causes more angst than trying to commit a fundamental belief to paper. This is compounded when a team must reach a consensus with respect to what those fundamental beliefs are. The finalalized foundation statement document has been reproduced below.

Ontario Association for Mathematics Education

A Vision for Learning Mathematics

The Ontario Association for Mathematics Education envisions a learning environment where all students do, see, hear, and touch mathematics in a profound and meaningful way. Our association sees the classroom as a community where teachers and students work collaboratively to learn and value mathematics.

In such a classroom, students engage in meaningful mathematical experiences through the use of concrete materials and manipulatives, visuals, technology, and other resources. Students build on their prior knowledge of key mathematical concepts and connect these concepts to their world. They understand the purpose of their learning through clearly defined expectations, goals, and assessment criteria. Students engage in inquiry, pose questions, and actively discuss their understandings with one another. Students demonstrate their understanding on a regular basis and strive to become independent and collaborative mathematics problem solvers.

Teachers use a variety of strategies that accommodate different learning styles and use resources to develop the investigative process in mathematics. They provide multiple opportunities for students to learn and apply mathematics in creative, purposeful ways while assisting and supporting students to help them achieve success in both independent and

collaborative tasks. To facilitate student learning, teachers provide feedback to students throughout the learning process. Teachers engage in opportunities for professional growth and continuously reflect on their teaching practices and classroom experience.

The learning of mathematics is supported through the active and ongoing involvement of students, parents, educators, and the community at large.

The learning of mathematics should be based upon the following beliefs and principles:

a) Learning is structured around the key concepts of mathematics.

b) Learners build on prior knowledge and understanding and work at a developmentally appropriate level to construct new personal meaning.

c) Learners are better able to transfer and use knowledge meaningfully when new ideas are presented within rich and meaningful learning contexts, and when learners make connections both within and outside of school.

d) The learning process is enhanced when new ideas are presented in a variety of ways and when all learners have access to "hands-on" and "minds-on" activities and opportunities. This includes the use of manipulatives, computers, calculators, and hand-held data collection devices.

e) Learning is enhanced when students experience a variety of instructional approaches, ranging from direct instruction to inquiry-based learning.

f) Learners require opportunities to interact with each other during the learning process, to teach others, and to explain and justify the processes of mathematics. Learning is enhanced when the learners are encouraged to communicate their understanding.

g) Effective mathematics education requires strategies that engage and motivate learners, that help students develop positive attitudes about themselves and about mathematics, and that encourage learners to make positive contributions to the learning environment.

h) Learning is enhanced when students and teachers understand learning expectations and assessment standards and participate actively in assessing and evaluating their personal growth.

i) Learning is enhanced when teaching, coaching, assisting, supporting, and feedback is planned and designed to improve specific learning and mental processing skills and to accommodate different learning styles and needs.

j) Learning is enhanced when teachers plan and reflect together.

k) Learning is enhanced when all participants in the process are active partners within a community of learners (e.g., parents, educators, students, and the community).

Learning Activities

A number of teams consisting of OAME Board members have been working diligently to produce sample activities that reflect our vision. These activities will illustrate "setting the stage," the appropriate use of technology and manipulatives, encouraging student/student dialogue, attending to a variety of learning modalities, rich assessment techniques, and bringing closure to consolidate learning. Two activities for each of Primary, Junior, Grades 7/8, Grade 9 Applied, Grade 11 College, and Grade 11 University are in production. Accompanying each student activity (e.g., blackline master), will be information about curricular connections, suggestions pertaining to lesson planning, assessment rubrics, and annotated student work samples.

The OAME Video

The video is a critical piece of the puzzle. The question is often asked, "What does a classroom look like, sound like, and feel like when Mathematics is happening?" The video captures images of student conversations and highlights small groups using manipulatives and technology. Teachers are shown introducing learning activities, facilitating conversations, helping individual students move forward, and helping students consolidate their understanding after they complete their tasks. The fundamental elements of learning and teaching excellence will be shown to be essentially the same for a Kindergarten class as they are for a Grade 3 class, a Grade 5 class, a Grade 8 class, a Grade 9 Applied class, a Grade 11 College class, and a Grade 12 University Advanced Functions and Introductory Calculus class. To illustrate this, clips from Kindergarten and Grades 1, 5, 8, 9, and 11 will be juxtaposed repeatedly under eight key headings relating to exemplary practice in the Mathematics classroom. For example, one category is the appropriate use of manipulatives. The video illustrates how students benefit from the use manipulatives from the time they enter

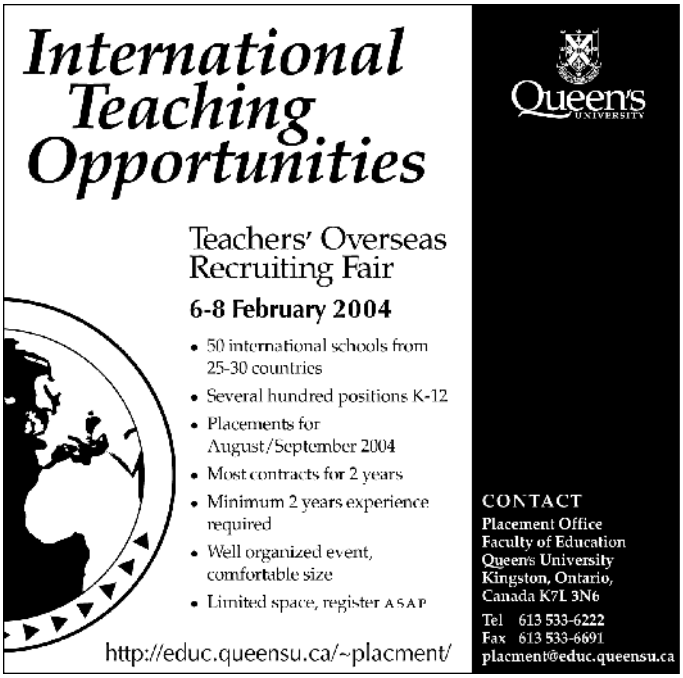
school until they graduate from secondary school.

Professional Development Strategies

This document is the piece that pulls it all together. It will be structured so that teachers, consultants, or administrators can structure meaningful inservice in their schools or in their Board. The Professional Development Strategies document will help connect the key ideas found in the Vision Statement to the images in the video and will illustrate how our beliefs connect to each one of the sample activities. This document will also provide practical suggestions for teachers, consultants, and administrators to help them initiate long-term discussions about how to improve student learning.

The OAME will provide a sneak preview of its video at this year's leadership conference in February, and a number of speakers will introduce various elements of the package to conference attendees. Distribution and implementation plans are still in the planning stages.

Speaking as President, I am very proud of every member of the Board of Directors, members at large who offered a great deal of help, teachers who field-tested materials, and students who gave it their best. These volunteers have put in countless hours over the last two years. They have given up weekends and worked late many nights to produce what I passionately believe is a superlative set of resources for the teachers of Ontario. Our efforts will continue until every student in the province is able to learn in a classroom where "Mathematics is happening." ▲



▲ Hey, It's Elementary: Defining and Developing Elementary Math Specialists



LINDA COLGAN

Introduction

No matter how hectic life is, I always make time to read my NCTM journals. Whether it is *Teaching Children Mathematics, Mathematics Teaching in the Middle Years, The Mathematics Teacher or The NCTM News Bulletin*, I consistently find that I learn something new about teaching, learning or assessing mathematics. In my role as a mathematics educator, I find that these journals play a role in keeping me a step ahead with fresh and creative ideas that I can use with confidence in my classes and workshops. But to borrow a line from Margaret Wise Brown, *the most important thing about these publications is* that they provide food for thought, points to ponder, and concepts to cogitate about … you get the idea.

For example, in a recent *NCTM News Bulletin*, Johnny Lott, the current President, states that the time has come for elementary (K- 5) mathematics specialists. He argues that major reforms to the mathematics curriculum precipitated by the NCTM *Standards* require expert teaching at all levels – especially during the foundation-laying elementary years. His contention is that the breadth and depth of mathematical content and process is far beyond the expertise of most generalist educators and he cites that there are precedents, e.g., master music teachers and physical education specialists have been the norm for many decades in many school districts.

Lott bases his call for specialists on *The No Child Left Behind Act*, which expressly states that by 2005, all American classrooms will have "highly qualified mathematics teachers."

Lott reiterates the recommendations of the *Mathematical Association of America* which state that all

prospective teachers should be required to take at least 9 semester hours on the fundamental ideas of elementary school mathematics (concepts, not mechanics, content in all five strands, the 'why's' of algorithms, and communication of mathematical ideas using a multiplicity of representations and mathematical conventions, terminology and formats). While this may be a step in the right direction, Lott argues, it is not enough to prepare elementary school teachers for the rigours of the curriculum and its constructivist tenets; hence, the need for specialists to teach, mentor and support the implementation of a *Standards*-based curriculum.

While Lott asks the question, "What makes a teacher a mathematics specialist?", recommends university-level course work as a way to develop prospective specialists, and notes that the students of more knowledgeable teachers score higher on standardized tests, he falls far short of providing an answer. In fact, I suspect the answer to this deceptively simple question would elude most of us.

I Know it When I See It – The Easy Task of Recognizing Expertise

Expert. Specialist. Master teacher. These are words and phrases that each of us has heard. In fact, many of us would contend that we know such a colleague. We have observed them at work in classrooms with children and we have learned from them at workshops and conferences. Each time we have an opportunity to watch them at work, we are inspired to develop and improve our own teaching by emulating the positive aspects of their practice in our own.

Any group of teachers asked to share a story about an expert known to them would likely describe an eclectic collection of educators who are very different in their own personalities and teaching style, who work with different ages and levels of students, and who run the gamut from young to old, urban and rural, public to private school. There is no one image of an expert teacher.

And yet, when we are asked to describe the criteria that define an expert teacher, we are often at a loss for precise words and explicit phrases. There are so many facets to being an expert teacher that it is hard to know where to begin when you look.

The Difficult Challenge of Codifying Expertise: The Work of Lee Shulman, David Berliner and Gaea Leinhardt

> *To be an expert public school classroom teacher is, we think, much harder than to be an expert physics problem solver. Berliner, 1986*

What does the research say about expert teachers? The question of the expert teacher has been studied from a variety of perspectives and continues to be a topic of significant study by leading mathematics education researchers including Deborah Ball. For the purposes of this overview, I will present two different 'spins' on expertise – the theoretical (Lee Shulman) and a cognitive/psychological perspective (David Berliner and Gaea Leinhardt) – all of which are remarkably consistent.

It is important to begin with a consideration of the seminal work of Lee Shulman in the mid-eighties. Originally, Shulman proposed three categories of content knowledge for teaching.

The first category, *content knowledge*, refers to the amount and organization of knowledge in the mind of the teacher. In Shulman's framework, *content knowledge* included knowledge of both facts and concepts, as well as an understanding of *why* those facts and concepts are true and *where* those facts and concepts fit in the larger disciplinary picture.

The second category, *pedagogical content knowledge* was described by Shulman as going beyond knowledge of the subject matter to the dimension of subject matter knowledge for teaching, e.g., knowing topics that children find interesting or difficult, the representations most useful for teaching a specific skill or process, and learners' typical errors and misconceptions. Because of their pedagogical content knowledge, experts were able to shape the opportunities they provided for their students. Pedagogical content knowledge is unique in that an expert teacher understands that the knowledge of mathematical content needed for *teaching* fractions, slope, or place value is vastly different from *knowing* any of these for oneself.

Shulman's third category, curriculum knowledge, involved awareness of how topics are arranged both within a school year and over time and it also includes knowledge of the ways in which to use curriculum resources, such as textbooks to organize a program of study for children.

Often Shulman's theory of content knowledge for teaching was described as having seven categories because he also included sub-categories in his field *general pedagogic knowledge* (e.g., classroom management techniques and strategies, knowledge of

learners and their characteristics, knowledge of educational contexts [such as school board politics, communities] and knowledge of educational ends, purposes and values).

At about the same time as the publication of Shulman's influential theory establishing the complex body of knowledge which teachers must know in order to teach, came the work of David Berliner, "In Pursuit of the Expert Pedagogue," a cognitive/schema theory research piece.

In his paper(which actually was the Presidential Address at the1986 American Educational Research Association meeting in San Francisco), Berliner tells us that there are a number of important reasons why we should study expert teachers. They are described briefly below.

Berliner believes that experts model exemplary performances from which novice or ordinary teachers can learn. Observing expert performance, Berliner says promotes thinking about the nature of the wide range of instructional strategies and outcomes to choose from and provides some decision rules about the appropriateness of various strategies.

Berliner believes that although mentor teachers have a great impact upon their mentees, they themselves often lack the ability to articulate the basis for their expertise and skill because their knowledge is in their actions, and those seemingly intuitive actions are actually fully automated procedures.

Berliner's research strategy was to study the routines of both expert teachers and novice teachers in order to understand how their behaviours differ. Through a microanalysis of an opening mathematics homework review task performed with expert and novice teachers, Berliner was able to make many of the experts' internal schemata visible.

In addition to the categories described by Shulman, Berliner's work suggests that pedagogical experts seem to differ from non-experts in other important ways:

1. The knowledge of classroom management, pace, level of intellectuality, affect, work orientation, influences the classroom's organization and management, and is the basis for transforming subject matter into knowledge.
2. Expert teachers make inferences about classroom situations; they don't just literally report what they see. They apply domain-specific knowledge to make sense of the classroom they are viewing.
3. As with experts in other fields, expert teachers categorize problems at some kind of higher level, not just by the surface characteristics given in the problem.
4. Experts have extraordinarily fast and accurate pattern recognition capabilities, like schema instantiations in chess experts.
5. Expert teachers are more opportunistic and creative in the use of equipment than novices.
6. Experts have better metacognitive or self-regulatory capabilities.
7. Experts are better able to anticipate problem situations and generate contingency plans than novices.

Berliner closes by saying that he considers expert teaching to be a much more monumental feat than conducting a symphony orchestra. He posits that the cognitive processes required for classifying classroom problems and developing solutions are the same for the experienced physicist and the experienced teacher, e.g., referring to the ability to solve problems in ill-structured domains. While he feels that the study of expert teachers will lead to some more codifiable knowledge than we already possess, he closes by asking why 'craft' knowledge is honoured in every profession except education. Berliner explained that his study could be used to boost professional pride and to begin the shift towards a new paradigm – so that just as in other fields, where members respect the expertise and 'craft' of their bridge players, chess players, or physicists, the same will happen with teachers.

Another researcher committed to the notion of expertise with respect to teacher knowledge is Gaea Leinhardt. Leinhardt usually chooses to study a topic that represents a pivotal moment in mathematics learning, e.g., fractions, ratios, and proportionality. As most mathematics educators know, these topics are milestones and students can either gain considerable understanding or become deeply bewildered because of them.

In her work, Leinhardt begins by researching the topic, learning about its instructional requirements and pitfalls, and then seeks to identify expert and novice teachers. Finally, she begins recording each teacher's instruction, gathering from five to 90 days worth of lessons on videotape and then coding, analyzing, and interpreting their content. In addition, her research team conducts in-depth interviews with the teachers about their professional development, career choices, and

subject-matter knowledge.

The significance of Leinhardt's studies is especially well illustrated in her comparisons of expert and novice teachers' conduct of lessons in fractions. She studied generalists (teachers who teach all elementary school subjects) in public school classrooms with 25 to 30 students each, an environment Leinhardt regards as "the acid test" for assessing instructional methods and performance. Not surprisingly, she found, that in general, the expert teachers were far more skilful than novices at all aspects of their job, from classroom management to the construction of clear and thorough explanations. As Leinhardt writes in a paper entitled "Expertise in Instructional Lessons: An Example from Fractions," she believes there are two aspects of knowledge for teaching: lesson structure knowledge and subject matter knowledge.

Expert teachers keep lessons flowing and are aware of and in tune with what their students are learning. They manage homework, seatwork, demonstrations, games, discovery projects, discussions, and drill with fluidity and consistency. Time is always treated as a valuable resource and is not squandered in getting set up and or by making multiple unintended false starts. Expert teachers teach very well – they give detailed, complete explanations and demonstrations, and provide rich mathematical experiences for their students.

Like Berliner, Leinhardt concluded that information transmission by a skilled teacher depends on highly implicit procedures. Leinhardt concluded that mathematics teachers are 'expert' when they:

- make sure subskills are in place;
- clarify(explain) the nature of the problem;
- represent the concept in several ways (numeric, manipulatives);
- specify the conditions and contexts under which a procedure is to be used;
- identify the principles that permit the procedure to be used;
- identify and check errors; and,
- connect new knowledge to old.

What is implied by the expert teachers' richer, more flexible, and more varied approaches and lesson components is that these teachers have succeeded in forging strong connections between their own conceptual and procedural forms of knowledge. They not only have a deeper understanding than novices about the subject matter and the cognitive problems it can present but a far stronger ability to anticipate and surmount those problems, monitor their own effectiveness, and negotiate the innumerable small activities that are embedded in the processes of classroom teaching and learning.

Moreover, as Leinhardt has documented in many classrooms, these expert teachers are often led by their conceptual understanding of their subject and their craft to incorporate many of the techniques identified by many constructivist mathematics educators as fruitful: discussion, discovery, collaboration, manipulatives, and facilitated guidance toward concepts.

Clearly, the value of this type of research is in its potential as a tool to promote growth in non-experts with the ultimate goal of more productive learning environments for students. But how?

Developing Expertise on a Broad Scale

The work of Shulman, Berliner, Leinhardt and others make it very clear that the knowledge of mathematics and knowledge about mathematics for teaching is very specialized and highly complex.

There should be tremendous validation for elementary teachers in the empirical recognition of the fact that there is much more to knowing and teaching foundational topics – "kids math" – than meets the eye.

The challenge now is to move more teachers to expert status and that can only be accomplished if professional

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development opportunities support teachers so that they can become career-long students of both content and pedagogy.

One of the best models currently available comes from Lee Shulman, the professor who started it all. Shulman believes that more teachers could become experts if professional development for teachers were to use real teaching cases that combine general and theoretical notions with questions about what can be done in a particular situation and why. Shulman argues that case studies could provide opportunities for teachers to examine alternative solutions or ways of teaching the same ideas and explore in depth both substantive content ideas and their pedagogy. He suggests that as an example, in math we might spend an entire session on signed numbers. Why are positive and negative numbers so critical? Why are they so hard for many students to grasp? What kinds of representations clarify these ideas and what are their limitations? He suggests that well crafted cases have drama and a narrative quality that are often more compelling than an expository presentation of the same ideas.

Shulman also believes that professional development could be positively impacted by the introduction into our schools of instructional case conferences. These conferences would be parallel in some ways to the case conferences held in teaching hospitals. Once a week or every two weeks a different teacher could take responsibility for presenting a case of teaching and learning – looking at instructional issues of some substance. The case presenter might say: "Year after year, we have this problem of having kids not understand what is means to divide by zero. They never get it right. Today, I'm going to talk about a series of things we did to remedy that this year and the evidence we have about improvement. Let me begin with a few minutes of explanation of what it means to divide by zero..." The teacher might show examples from students' learning portfolios followed by an account of common mistakes kids make and the recurrent difficulties they have. Later in the case conference, the teacher might show a segment of video or other examples from portfolios to illustrate where students are now.

Shulman not only believes that these types of experiences could be enormously exciting and powerful forms of staff development – he has the empirical evidence to prove it. He has developed, with his research team, the Mathematics Case Methods Project[1], in which teachers work with other teachers using math cases that portray real-life teaching dilemmas. In one case, for example, a student asks the teacher: "How can 100 percent of something be just one thing?" The question, itself, can give a teacher pause. Although most of us would agree that 100 percent means the whole thing or "one," the concept can be confusing. If you poll 23 people and 100 percent respond that they like toothpaste, does 100 percent mean 23 or 1? What seems obvious on the surface is really quite complex when you're trying to promote understanding of a concept and not just memorization of a rule.

A case like the one above reflects reality and illustrates that many fundamental mathematics concepts are more complex than they might initially seem – especially when seen through the eyes of the child or the practitioner.

It seems only logical that expert models of teaching would require expert models of professional development. And professional development that helps teachers learn to connect theories and concepts to the complex world of their own idiosyncratic classrooms while simultaneously enhancing analytic thought, reflection, inquiry, and, content knowledge, seems to be worth a try.

[1] *For more information on the Mathematics Case Methods approach, contact Judith Shulman (shulma@wested.org) or Carne Barnett (cbarnet@wested.org).*

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▲ Jack Weiner's Friday Specials!



JACK WEINER

Hello, everyone. Well, it's nice to be back in the *Ontario Mathematics Gazettte*. It's especially nice to be back contributing a column but not having to edit the whole darned issue. Been there, done that, from 1992 to 1996. It was exciting and exhilarating and I felt that I was making a significant contribution to the Ontario mathematics education community.

But it's Marilyn's turn. She has to maintain and even raise the high bar set by Louis Lim and John Egsgard. Judging by September's *OMG*, I have every confidence that she will raise the bar even higher.

Fridays at the University of Guelph, five minutes before the official end of my class, I instruct my students (now up to 1000! That's "!" for emphasis—God forbid, it should in this context be for factorial), "Pens down, books closed, it's Friday Special time!"

Then I show on screen an article or cartoon or letter or…something that has to do with math, the "real world" and has absolutely nothing to do with class, assignments or tests. It is math for fun. Often, it is some flagrant example of how the media abuse math. I tell you truly: the students need only one Friday special early in the fall semester to drool, Pavlov like, in anticipation every subsequent end of week.

So here, I propose for the next couple of years, to share some Friday specials with you. I hope you enjoy them. I hope you use them. Make them Monday morning specials, or just, "We need a break!" specials. If one falls flat, you are welcome to blame me. If a Friday Special goes over well, you take the credit.

Now, having built up your expectations, I would like my first column to be an exception. With the new curriculum and especially facing the double cohort in my classes, I am going to share with you something I have used successfully both as a high school teacher and a university teacher for, well, a long time. This works! And is more relevant now than ever. I hope you approve. I hope you use it. I hope at least one of your students becomes a better math student by applying it: "How to get an "A" in Math!". See you next issue. ▲

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How to get an A in math

1 After class, **DON'T** do your homework! Instead, read over your class notes. When you come to an example done in class...

2 **DON'T** read the example. Copy out the question, set your notes aside, and do the question yourself. Maybe you will get stuck. Even if you thought you understood the example completely when the teacher went over it in class, you may get stuck.

And this is **GOOD NEWS!** Now, you know what you don't know. So, consult your notes, look in the text, see your teacher/professor. Do whatever is necessary to figure out the steps in the example that troubled you.

Once you have sweated through the example, **DO IT AGAIN! And again.** Do it as often as you need so that it becomes, if not easy, then at least straightforward. Make sure you not only understand each line in the solution, but why each line is needed for the solution.

In part, you have memorized the solution. More importantly, you have made the subtleties of the problem unsubtle!

This is the great equalizer step. If your math or science aptitude is strong, then maybe you will have the example down pat after doing it twice. If not so strong, you may have to do it several times. But after you have done this for every class example...

3 **DO YOUR HOMEWORK!**

If you follow this method and if the teacher chose the examples well, then most of the homework questions will relate easily back to problems done in class and the rest should extend or synthesize the ideas behind those problems.

Guess what you'll find on 80% or more of your tests and exams? The same kinds of problems! And you will have your "A". Good luck, although if you use this method, luck will have nothing to do with your INEVITABLE success.

Reprinted from *The Mathematics Survival Kit*, by Jack Weiner, published by Thomson/Nelson, Canada

Have your questions ready. When you see your teacher for extra help, don't say anything like, "I don't have a clue what's going on." Rather, work through your class notes – definitions, examples, theorems and proofs – thoroughly, and be prepared to say, "I understand everything up to this point. How did we get from here to here?" In other words, do your part! Spend quality time with the material.

Get into study groups. Then one representative of your group can see your teacher to help with problems and report back to the others. Also, with group expertise, more often than not, you will solve most problems yourselves.

Struggle more than a little. Don't give up after one attempt. Make a sincere effort to sort out your problems. That way, when you say, "I am stuck RIGHT HERE!", you will be so up on the problem that your teacher's words of wisdom (I am not being sarcastic here!) won't seem like a foreign language.

Have you ever had that experience? A teacher is explaining something as if it is the most straightforward concept imaginable. You are nodding your head, saying, "Uh huh! Uh huh! Got it." And you're thinking, "I don't have a clue about what this teacher is talking about." It's rare, but sometimes this is the teacher's fault. Often, though, the blame lies with the student, who hasn't struggled enough so that the teacher's explanation can work. Struggle more than a little!

SOME SPECIFIC STRATEGIES

- Review each day's notes as soon as possible – definitely before the next class.
- You should, on average, do a minimum of one hour of homework per class.
- Participate in class.
- Form study groups with classmates.
- Don't fall behind.

▲ OAME/NCTM SEPTEMBER 2003 REPORT

FRANCES SCHATZ



NCTM.org Introduces New "MEMBERS ONLY" Features

NCTM has responded to members' requests re online member benefits. There is now a Members Only section. Look for the (red pentagon with a white M).

Individual member benefits include journals, news bulletin, electronic access to Student Math Notes, teacher resources organized by topic, funding opportunities, member discounts and other resources at www.nctm.org/members. Your login password comes with your membership package. For a Canadian application (25% cap on exchange) please contact this writer for a membership form.

Annual Report to OAME Members

I am pleased to report that the affiliate sales program that replaced consignments is working very efficiently for Ontario. Your mail orders keep this part of my work exciting and interesting. If I don't have the item available and it is in print, I can have it to you within two weeks if it is a prepaid order. Please request a list of publications that are out-of-print before **March 31, 2004**. I will include the clearance price that will include shipping costs.

New Publications with NCTM Canadian Prices Effective to January 31, 2004

- #12340 *Children are Mathematical Problem Solvers* Non-member $36.25, Member $29.00 This publication won an Award for Excellence in the National Association Publications annual competition.
- #12325 *Navigating Through Data Analysis in Grades 6-8* Non- member $46.15, Member $36.90.
- #12326 *Navigating Through Data Analysis in Grades 9-12* Non-member $58.40, Member $46.70. My preview of this book indicates it will be a wonderful resource for the project ideas needed for Mathematics of Data Management.
- #12523 *Navigating Through Measurement in PreK-2*. Non-member $46.15 Member $36.90
- #12327 *Navigating Through Probability in Grades 6-8* Non-member $58.40., Member $46.70

Authors Needed for NCTM 2006 Yearbook

The focus will be *Thinking and Reasoning with Data and Chance*. For a copy of the guidelines visit www.nctm.org/publications/yearbook.htm. Potential authors should submit a first draft of the proposed manuscript by **March 1, 2004**. Ontario teachers – please forward your ideas for this yearbook. I would like to see Canadian content as we did in the Fractions Yearbook two years ago.

NCTM Annual Conferences

- **Philadelphia, April 21 – 24, 2004**. Watch the web site for the preview brochure.
- **Anaheim, April 6-9, 2005**. Watch the web site www.nctm.org/annual for more information.

Special Order to Please You

A most popular item for Ontario math teachers is the 'I Love Math' Postcals –a postcard with heart stickers that all say 'I Love Math'. NCTM discontinued them, so I asked if they would do a special printing of them. My wish came true. The price is CAD $1.00 includes GST and shipping. The original price had gone to $1.25 until they were discontinued. On your order write the number #6020. The price is the same member or non-member. These make great motivator awards and 'surprise mail'.

An Offer for a School Library

Since I have been a member of NCTM, I have a great collection of Math Teacher journal sets from 1985 to 1995 that I would like to give to a new home before I retire as your NCTM representative. This would appeal to a new school or a personal library. The recipient can arrange for pickup or assist me with delivery/shipping costs. It would be wonderful to see these journals that are in excellent condition go to a resource centre where others can use them.

Frances Schatz ▲

▲ BOOK REVIEW: *BIG IDEAS FOR SMALL MATHEMATICIANS*

REVIEWED BY LAURIE MOHER

Laurie Moher is an Educational Services Advisor with the Kawartha Pine Ridge DSB. She is on the Board of Directors for OAME. She was a member of the Early Math Strategy Expert Panel.

This book is very timely considering the current focus on mathematics education in Ontario. Anyone involved in the roll out of the Early Math Strategy training has become familiar with the term 'Big Ideas'. This book is a collection of 22 hands-on mathematics explorations geared to a range of grades. The author Ann Kajander created a mathematics project called the 'Kindermath Enrichment Project' in 1994. She currently teaches at a grade 9-12 school and teaches pre-service elementary teachers at Lakehead University in Thunder Bay.

The structure of this book makes it easy to follow and use immediately in the classroom. Many of the activities require little preparation or use readily available materials. Each activity is set up as follows:

The Big Idea: Here the author summarizes in broad terms the main concept or concepts that are being addressed in the activity. For example, in the activity 'Pattern Shapes', the Big Idea is that "Geometric patterns are the very essence of discovering new mathematical relationships" (p.1).

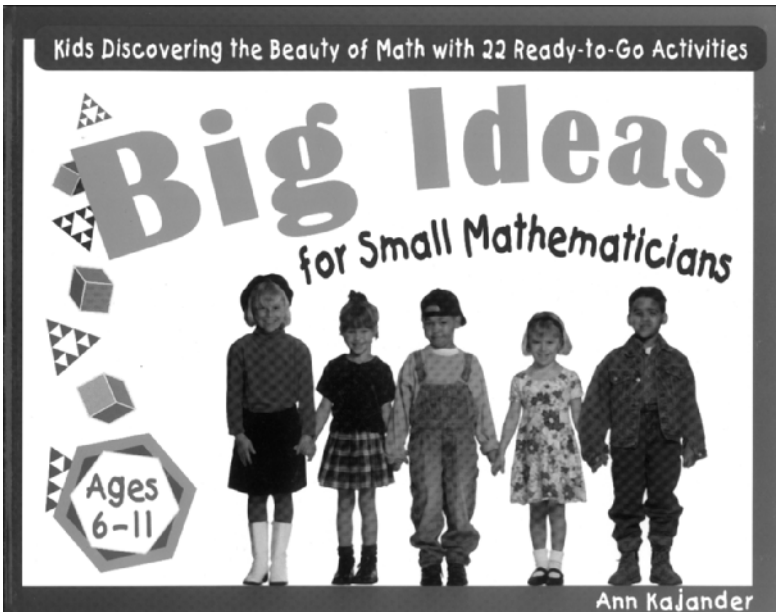
Content Areas: This section outlines the math content that will be addressed in the activity. This is similar to our Ontario Curriculum math strands (or sub-topics within the strands). Many of the activities cover more than one strand. For example, in the activity 'Soma Cubes' the content areas are three-dimensional visualization, volumes, sketching in three dimensions and geometric terminology (p. 24).

Process Skills: This section relates roughly to what we would call the categories in our curriculum. In this same activity, reasoning and problem solving are highlighted.

Prerequisite Knowledge and Skills: Because the activities are very concrete in their approach most children will be able to enter into them on some level. If there is particular content knowledge required for understanding the math behind the activity, it will be listed in this section. In the activity 'Discovering Pi' the prerequisite skills are single digit addition and double digit addition. It is also noted that it would be helpful to have the skills of single digit multiplication and division.

Age Appropriateness: This section sometimes gives an age that would be appropriate for doing the activity and sometimes is written in general terms (younger children, older children). As the author points out in the beginning of the book, "many of the activities are suitable for all ages, with varying degrees of adult assistance". (p. viii).

The Mathematical Idea: Here the author describes the mathematics involved in the activity. This section provides the background knowledge that teachers will find useful in order to help students get the most from the activity.



Helpful Terms: This is an easily identifiable box on the page that lists the 'math language' particular to the activity. In addition to the term itself, a definition is provided.

Making it Work: This section contains the detailed instructions for making the activity work in the classroom.

Often included in this section are 'tips' (e.g., how to demonstrate the activity) and ideas for extending the activity further.

Activity Sheet: These pages have the step-by-step instructions for completing the activity but they are geared toward the students. They often include pictures and 'hints' to help them complete the activity.

This book immediately caught my interest because of the easily recognizable format. It can be picked up and used without having to take a lot of time to figure out how it works. I like that the activities are cross-stranded and encourage both problem solving and communication in math. In addition to the math terminology highlighted in each activity, there is also an illustrated math glossary at the back of the book.

The age appropriateness of a particular activity is often given as an age range. For example, for the activity 'Soma Cubes' the range given is 8-10 year-old children. This is a helpful guideline, however, teachers will need to ensure that the activity they are using matches the curriculum expectations for their particular grade. On the cover of the book the age range is 6-11. I believe it actually covers a larger range than this. For example, toward the end of the book there is an activity called 'Proof with Pythagoras and Fermat' which would be suitable for Grade 8 students. Some of the other activities, with slight adaptations, may actually be suitable for a wider grade range than stated in the book. As an example of this, I have done the activity 'Tetrahedral Fractal' with Reading Buddies. We added string and made our tetrahedral fractals into kites. The older students used the activity to focus on the mathematics, the younger students used it to focus on Science.

Adaptations for students experiencing difficulty were not specifically outlined in a boxed section but were included in the section 'Making it Work'. Assessment information does appear under a separate heading and the suggestions are very general in nature.

Aside from use in the classroom this book offers excellent activities to include in a math 'home bag' program. The activities would also lend themselves to a Family Math Night or a Math Olympics event. Because this book is suitable for a number of different grades, it is a book that could become a valuable part of a school resource library. ▲

▲ WEB SITES: GET INTERACTIVE

KEVIN MACGUIRE



Kevin Maguire is an Instructional Leader in Mathematics/Numeracy for the Toronto District School Board. Kevin is also an OAME Director. His particular interests include teaching with technology and elearning.

In this column, web sites of interest to teachers of mathematics will be shared. In this issue, the spotlight is Interactive web sites.

Java Applets
http://math.bu.edu/DYSYS/applets/

Chaos! That is the purpose of this site. Try your hand at creating fractals, or work through the Towers of Hanoi problem.

For comments and sug-gestions write to Robert L. Devaney at bob@bu.edu

National Library of Virtual Manipulatives for Interactive Mathematics
http://matti.usu.edu/nlvm/nav/vlibrary.html

This site features java applets which simulate most popular manipulatives. Geoboards, pattern blocks, base ten blocks etc. In addition, there are a number of interesting and challenging activities to dem-onstrate the use of each virtual manipulative. These activities are cross-referenced by grade and strand.

Illuminations – NCTM
http://illuminations.nctm.org/

"Interactive Math Tools are Java applets you can use to explore math and create interactive lessons. See our i-Math Investigations for examples of lessons that use some of these tools."

The Illuminations section of NCTM is designed to highlight the wide variety of web-based strategies and resources that can "illuminate" the NCTM Standards. ▲

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▲ Learning Mathematics With Projects and Problems: Classroom Examples Involving Math, Science and Art for the Junior Level



ANN KAJANDER

*Ann Kajander received her Ph.D. in mathematics education from the University of Toronto where her area of study was giftedness and creativity. She has published articles in T*eaching Children Mathematics *and has presented at the NCTM conference and the Canadian Mathematics Education Study Group meeting. She currently teaches at a grade 9-12 Thunder Bay public school and has run the Kindermath Enrichmnet Project since she created it in 1994. She is an adjunct professor in the mathematics department at Lakehead University where she teaches pre-service elementary teachers.*

Following the publication of the initial National Council of Teachers of Mathematics *Standards* in 1989 and subsequently Standards 2000 (NCTM 1989, 2000), many local curricula have been revamped. In Ontario, for example, a new elementary curriculum was released in 1997 (MOE), with a new secondary curriculum following soon thereafter. Debate continues however, as to whether these documents actually support the mathematics education reform movement, and if not, what the nature of reform ought to be.

At a recent conference on on-line learning in mathematics sponsored by the Fields Institute of Mathematical Sciences, plenary speaker Seymour Papert described mathematics as "the problems" [to be solved] (on-line webcast, February 2003), rather than the lists of concepts which commonly exist in curriculum documents. In June of 2003, a working group of the Canadian Mathematics Education Study Group drafted a working paper in which this organization endorsed the understanding of mathematics as developed through the problems themselves, rather than the lists of concepts. Included in this paper is the idea that the lists of concepts in existing mathematics curricula may need to be drastically reduced in order to allow time to investigate real mathematical problems, suggesting that only through working with mathematical problems will true mathematical learning take place (Davis and Whitley, forthcoming).

Most of us, as classroom teachers, likely believe we do not have the judgement or background to create or choose appropriate problems for such a vision of mathematics learning. However, over the last nine years I have had the opportunity to participate in a project in which I had the chance to experiment with projects and problems in mathematics environments for elementary children. My experiences in this environment, called Kindermath, relate to these issues and have been most interesting.

Kindermath began in 1994 when some parents of elementary children approached me with the plea to create some opportunities to excite their children about mathematics. While the name came from the German word *Kind* meaning "child", the English word "kind" has also been suggested to me as a possible interpretation of the name. I had no idea, that first Saturday afternoon, how far this beginning experience would take me! I was in an enviable position: parents – and children – *wanting* some exciting experiences in mathematics, with no set curriculum or evaluation structure to hold us back.

As I began to develop activities for the growing Kindermath program, I began to ponder what it was that I thought young children could understand and appreciate about what intrigues mathematicians about their subject. I began to set out an informal list of criteria for the activities in my head: the activities must point to something important in mathematics, include something intriguing or beautiful, possibly surprising or unexpected, and have hints of important concepts such as dimension, infinity, reasoning and so on, wherever possible.

This personal experience has encouraged me to think that it might just be possible to learn a surprising amount of mathematics through problems and projects, letting the "list" emerge after the fact. In environments such as Kindermath, we *begin* with the problems, and *end* with the list of concepts which were investigated, *not the other way around* as in most current mathematics curricula.

Many of the activities in Kindermath are open-ended,

and can be directed (or not) to the extent the facilitator wishes. As illustrative examples for this discussion, I have included two activities which are relatively more directed, and hence would be fairly easily accessible to current classroom situations. The activities involve geometry, patterning, measurement, fractions, and division at the junior level, and can also be tied to the science and art curriculum.

In the following sample projects, the mathematics behind kaleidoscopes is examined with classroom activities. As well as connections to art, for example the principles and elements of design strand in visual arts, and science, for example the light and sound strand in grade 4, the investigations incorporate concepts of numeracy (division, partitioning into fractions), geometry (reflections, rotations, and tesselations), measurement (angles and degrees), and patterning. An appreciation of the beauty of mathematics may also be developed. At the end of the first activity described here, children will have an attractive "suncatcher" or stained glass window design which may be framed in construction paper and used as a gift. To follow, "classroom-safe" kaleidoscope construction is described, at a cost of about five to ten dollars each not counting the Pringles chip can. One kaleidoscope per group is sufficient to construct, and materials can be reused. Children must solve the problem of finding the correct mirror angle to make a symmetric rotational pattern. They must also determine how to use reflection in creating rotationally symmetric patterns.

These activities were inspired by the work of Hodgson (1997) and Klaus-Dieter and Hodgson (1990, 1998) and have been used in fourth to sixth grade classrooms, the Kindermath program, and with pre-service and in-service teachers as examples of multi-strand, interdisciplinary mathematical investigations. Further details on these and other activities can be found in Kajander (1999, 2003).

The Classroom Activities

My work with students often begins with students examining rotational patterns. Then I show them commercial kaleidoscopes and then ask them to describe the patterns within. Their goal is to solve the problem of correctly determining the mirror angle to create such patterns. This discussion could include the review of previous concepts such as fractions as equal parts of a whole, division, reflections, symmetry, and angle measurement. Small groups or pairs of students could then be given two small rectangular mirrors and asked to use magazine pictures to investigate reflecting portions of pictures between the mirrors. Students can be asked to investigate how rotational patterns such as in the kaleidoscopes were formed, but depending on time, generally need the clue to hold the two mirrors upright, but touching on one edge, forming a wedge shape (glass facing in). When they look into the mirrors forming the wedge, an image can be seen reflected in a rotational pattern. The challenge is to find those wedge angles that make a complete rotational pattern as in the kaleidoscope.

Small groups of students work with a pair of mirrors and a colored picture book. When they hold the mirrors together in a wedge shape on top of a picture and look into the wedge, they see the picture partially reflected. Changing the angle of the wedge is done by rotating one mirror. Children are encouraged to look for those angles that make a complete rotational pattern when they look into the wedge shape made by the two mirrors. I find children are readily able to identify such complete patterns. For example, at 90˚ four images are seen when looking into the mirror wedge but pivoting one of the mirrors results in an incomplete pattern. (Try it!)

It may be necessary to remind children how to calculate the angles and to review 360˚ as the measure of a complete rotation. Geometry, measurement, and concepts of division and fractions are all involved, and connections are ripe to be made among these areas. Looking at measurement and division, for example, and seeing four images in the pattern, calculating the "wedge angle" (possibly with a calculator) is done by computing: $360^\circ \div 4 = 90^\circ$.

Thus each piece is one fourth of the whole, and 90 degrees is also one fourth of 360. Similar reasoning can be used for other divisions of the whole, making a connection among division, fractions, and measurement. These connections can be pursued more or less deeply with related examples and problems as the teacher chooses. Children can then be challenged to calculate other angles that yield a complete pattern.

Sharing results may give lists like this:

$360^\circ \div 4 = 90^\circ$

$360^\circ \div 6 = 60^\circ$

$360^\circ \div 8 = 45^\circ$

While 7 does not divide evenly into 360, 5 does. Looking closely at 5, however, we see that the pattern will not actually work out with an odd number of pieces because the pattern can not alternate or reflect (unless

the picture in the wedge is exactly symmetric). This is why it is useful to use a magazine picture to trace, rather than a small item such as a penny, which is symmetric and will not show the reflection as different from a rotation. Because 5 is not even, it will not give an alternating reflected pattern, and the pattern wedge farthest from the eye will be unclear.

At the fourth grade level and with students still constructing the notion of division, students needed help understanding the relationship between the 360 degree total angle and the number of pieces in the pattern to form the wedge angle, but many grade five students find it obvious. I have also done these investigations with grade three students and younger without worrying about the measurement or division aspects, but rather as a way to investigate rotational patterns and transformational geometry visually.

Mathematical follow-up could take a number of avenues, and the decision of which to follow might be best done based on the students' responses to the activity. For example, in one grade four class we began with a discussion of angles and measurement before we constructed the suncatcher, and than used the suncatcher as a way to connect the concepts of division and fractions. The kaleidoscopes were then built and decorated with tesselations as part of other activities involving transformational geometry. I found that the students were able to return to the objects they had made and use them as a concrete basis for subsequent discussions of related mathematical concepts. The kaleidoscopes in particular were highly valued by the students as evidence of the mathematics they had learned.

The details of the suncatcher task are found in Activity 1 and the kaleidoscope construction in Activity 2 to follow.

Mathematics is all around us, even in things we can play with. Investigating the mathematics behind intrinsically motivating objects such as kaleidoscopes makes the work both meaningful and interesting. As well, a number of mathematical strands are involved in the activities. Overlapping into other subjects such as science and art provides the extra time often needed for meaningful exploration, and the connections made as required by the Standards. The intrinsic beauty of mathematics, and its need for pattern and predictability are characteristics of the subject appreciated by mathematicians, but may be hard to convey to young children. From this activity, children may have had an opportunity to glimpse some of this intrinsic beauty. Further research is needed to show how learning in such activity based environments compares with more traditional situations and how such learning fits into the vision of mathematics as problems rather than lists of concepts.

Activity 1

Teacher Notes for Creating the Suncatcher

Materials:

- scissors, acetate pens, acetate as in Figure 1 template

As discussed above, the activity should be preceded by an examination of kaleidoscopes, and a discussion of the mathematical concepts such as rotational patterns, angle measurement, and so on. To avoid the issue of odd and even numbers of pattern pieces, each student may be handed an acetate transparency pre-printed as in Figure 1. The three wedge angles are 45˚, 60˚ and 90˚, and students can measure them with protractors to find this out. If time permits however, I prefer to let students find these angles themselves by investigation.

Students are asked to choose and cut out a wedge shape from the acetate template or create their own. Then they must trace a partial figure or drawing out of a book onto the wedge template with acetate pens. (Note: tracing works better than drawing, because tracings are less likely to be symmetric.) Holding the mirrors on the edges of the acetate wedge on which they have just done some tracing and looking in to the mirrors will remind them of the kaleidoscope-like picture they are trying to create on the circle.

The first part is easy: they simply trace the wedge image onto the acetate circle, lining up the center of the circle with the tip of the wedge. (Place the wedge to be traced under the circular shape). Then comes the challenge: how do we make the next part of the pattern? Encouraging students to talk about what the mirror does helps them construct the idea of a mirror giving a "reflection".

A reflection can be modeled by "flipping" the wedge over and tracing from the other side of the acetate. Continuing this process carefully will result in the final suncatcher (see Figure 2).

Children need to be encouraged to trace carefully, and overlap the edges of the wedge when tracing so the wedges will not "grow" in the design. They may need to be reminded to compare their drawing with what they

saw when they held the mirrors on the radii of the initial wedge; many students will initially forget to reflect the image each time they trace it. Children (and adults!) will express excitement as the design grows. Coloring the circular designs and mounting in a black paper frame will result in an attractive stained glass window or suncatcher, a concrete reminder of their mathematical activities.

Activity 2

Teacher Notes for Constructing the Kaleidoscope

The actual construction of kaleidoscopes is a fun follow-up to the previous activitiy, can be done in math or science class, and again provides a concrete verification of the ideas discussed.

Most kaleidoscopes use the 60˚ angle, resulting in a hexagonally repeating pattern, although octagonal ones and others such as decagonal are also found. Continuing the discussion of angle measurement and division into geometry allows students to easily see that in the hexagonal case, since the area has been divided into 6 equal parts, each triangle has a center angle of 360˚ ÷ 6 or 60˚. Since the triangle sides forming the radii are all equal, these triangles are isosceles. So the base angles are (180˚ – 60˚) ÷ 2 or 60˚ as well; hence the triangles are congruent and equilateral. Such discussions support a further study of congruent, isosceles and equilateral triangles in math class.

Reviewing the discovery of the 60˚ angle can be done by holding two mirrors in a wedge shape with a picture or object on the table between them. When they are at 60˚, exactly 6 images will be seen.

Kaleidoscopes can be easily constructed in the classroom with a minimum of commercially available supplies. Grade four and higher grade students will be able to do most of the work themselves, but younger students may need some assistance. Students can work in groups, and materials can be reused from year to year to reduce expense, or parents can be given the option of contributing so each child can keep the kaleidoscope (about $10.00 each in total).

Materials

- 1 Pringles chip can (empty!)
- 3 “Goody” purse mirrors (about 5 cm x 8 cm), available in drugstores and department stores for about $1.50 each)
- Acetate transparency circle cut to fit inside the can
- A handful of small translucent beads, bits of colored cellophane, or other colored translucent objects
- Tape

Preparation

Using a hammer and a large nail, a hole about 1⁄2 cm in diameter will need to be punched in the center of the metal end of each chip can, by an adult.

An acetate circle must also be cut to accurately fit inside the can and this can also be done in advance. Cut the can off about 2 cm longer than the longer measurement of the mirrors, leaving on the metal end.

Assembly

1. Tape the longer sides of the 3 mirrors together to form a triangular prism with the mirrors facing inwards. Children should look down the triangular tube to see what happens.
2. Now slide the mirror prism into the prepared chip can, all the way to the metal end with the hole. A bit of crumpled paper between the backs of the mirrors and the can will keep them from rattling.
3. Cut out a piece of acetate in a circular shape to fit the inside circumference of the can. Tabs can be cut around this circle to make it easier to secure to the insides of the can. Place this circle flat on top of the mirrors. Tape the tabs to the inside of the can. This keeps the beads in place – the acetate forms a barrier between the beads and the mirrors.
4. Now the fun part! Experiment with beads and other objects, putting them between the acetate and the plastic cover of the can. The cover will need to be taped on the end to hold it on once the end of the can has been cut off. The combination of beads can easily be changed by removing the lid.
5. Turn the can to enjoy the patterns!

Decoration

An “Escher” tessellation pattern is an ideal decoration for the outside of the can. (Students who are familiar with tessellations can be challenged to determine the size of an initial square or rectangle to tessellate, so that the pattern will meet up with itself going around the outside of the can (an exact fraction of the circumference is required for the side length of the initial square, such as one quarter or one fifth of the circumference). The tessellations can be drawn and colored on a sheet of white paper, and glued to the outside of the cylindrical can.

This activity has been accomplished successfully with students ranging from age 7 to adult. Be sure to allow students to share their varying and exciting products with their classmates. Cries of "cool – look at this one!" will no doubt be heard.

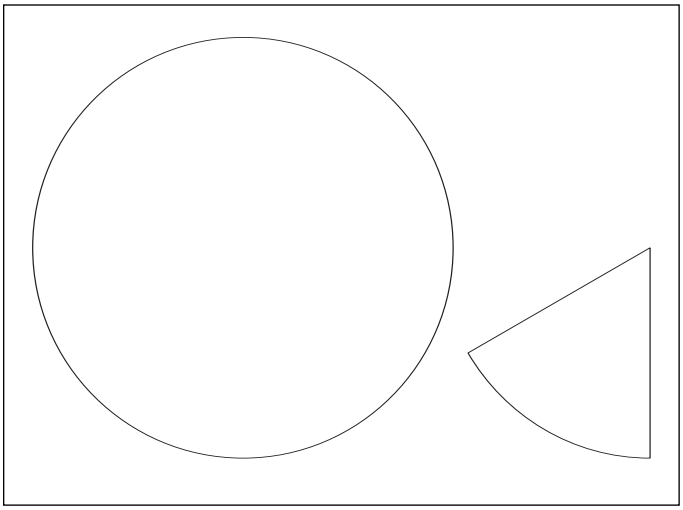


Figure 1 Acetate circle and wedge.

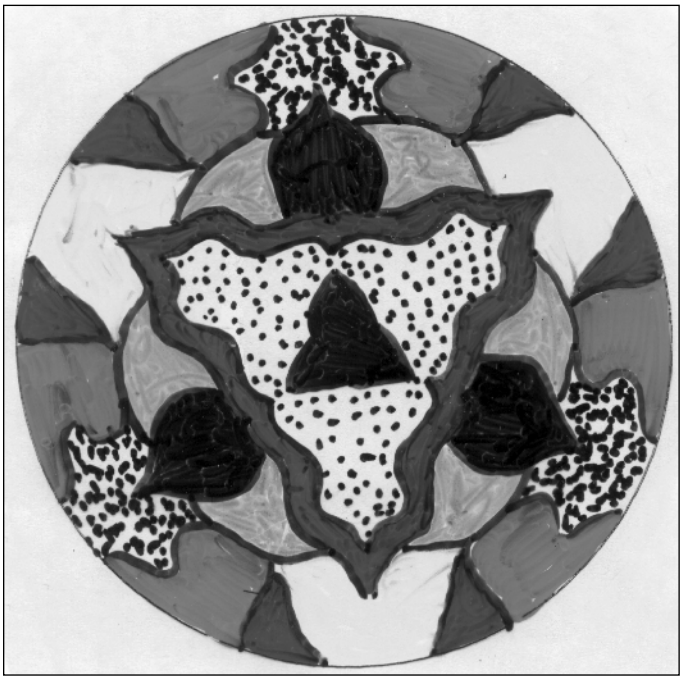


Figure 2 Completed suncatcher.

Variation

For a slightly higher cost, a superior quality kaleidoscope can be made by using custom cut mirrors from a glass shop, without cutting the "Pringles" chip can.

A glass shop will cut mirrors to about 3.3 cm in width, about 20 cm in length. The mirrors should be tested to fit, as the thickness of the glass will affect the exact size of mirror needed. The shop must be cautioned to buff the edges of the mirrors, and teachers may prefer to insert the mirrors into the can themselves, or just make one as a demonstration for the class. Cost of the glass will be slightly higher than using the purchased mirrors, about $12.00 per set of three mirrors. However, the quality of the kaleidoscope will be far superior, due to the improved ratio of length to width.

Acknowledgements

I appreciate the input and enthusiasm of Bernard Hodgson who generously shared his kaleidoscope research with me and encouraged me to write up these ideas, as well as the translation help of Lori Ruberto. I also appreciate the help of the teachers who allowed me to field test these ideas in their classrooms, the contribution of Colleen Modeland, and the support of Lakehead University.

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OAME 2004

▲ Director's Dialogue



Jacqueline Hill is a teacher of mathematics at Port Perry High School. Her involvement in the mathematics education community includes Course Profile writing, Workshop Leader, Pine Ridge Math Association President, and writer for Nelson Thomson Learning.

Win! Win! Win! This is the Winner's Corner!

All you have to do is read the Director's Dialogue and answer a simple question about the material read, and you could be a winner! Mary Bourassa of COMA was the first to correctly answer the question in the Septmeber 2003 Director's Dialogue.

This edition of Director's Dialogue highlights events at the Friday and Saturday, October 3 and 4 2003 OAME Board of Directors' meeting at the Delta Airport West Hotel in Mississauga.

The Board Meeting began at 6:50 pm. President Stewart Craven noted that the major initiatives of OAME for this year are: The Vision Project, web site redesign and changes to the *Gazette* and *Abacus*.

Other Highlights include

- **Web Site Committee:** The Committee reviewed 4 responses to their RFP and made a selection in July 2003. The criteria were:1. The development and evolution of the web site had to be dynamic and flexible, to permit OAME to fully envision its needs and priorities over time. 2, Input and control, both content and technical, had to remain in OAME's hands throughout the process, including future maintenance. The Committee recommended the selection of Tasso Kostalas, to work in an iterative/collabrative partnership with the OAME Executive.
- **Chapter Reps meeting:** Greg Clarke stated that Ontario Math Olympics will be a priority this year. The executive has suggested that each Chapter appoint an OMO co-ordinator who would know who their teams are, be sure they get complete registration packages and sample contests and ensure they register properly. The Futures Committee is also working on OMO.
- **NCTM rep 2004-7 appointment:** Stewart Craven reported that the executive has selected John Kersley to be the NCTM rep for OAME for 2004-2007. John Kersley recognized the excellent work of Frances and Frank Schatz, who received a standing ovation from the board. See Frances Schatz' NCTM Report on page 26.
- **OMO 2004:** Jacqueline Hill reported that the dates are June 18 and 19 2004 at Durham College. Packages will be given to chapter reps in February 2004. PRMA gave a further $15 000 to OAME from the OAME 2003 Annual Conference
- **Awards:** Judy Dussiaume encouraged people to nominate people in their chapters for 5 OAME awards by Jan 31 2004, and for the Union Gas awards. The form is in the *Gazette*.
- **Nominations for Board:** Marg Warren requested nominations for President-Elect, 2 Vice Presidents, and directors by Jan 23 2004.. Various members requested more Elementary reps. It was suggested that Secondary Chapter reps run for Director and bring in a new Elementary chapter rep.
- **OAME is now accepting VISA and Mastercard** for payment of memberships, purchase of documents and registration at OAME Annual Conferences.

Chapter Reports

(See Upcoming Events page 11 for Conferences near you)

CHAMP- Rep: Fred Fernyhough: fred.ferneyhough @peelsb.com. The executive is currently appealing to math teachers in Peel and Halton for assistance with organizing events and attracting new members.

COMA - Rep: Peter Lenczewski: petelenc@ compmore.net. COMA again has an activity filled year planned for the membership. The planning committee has met a number of times already and the organization of all the events is progressing nicely. Further details will be forthcoming.

GOLDEN - Rep: Ed Haines: ed.haines@ dsbn.edu.on.ca. No activities are planned until our annual spring conference at Brock University in early April 2004 . These workshops will be posted on our web site as more information becomes available. http://www.dsbn.edu.on.ca/Schools/Golden/. Anyone interested in participating in the planning of these

sessions can contact us through the web site.

GVMA - Rep: Paul Fennell:

GVMA is proud to announce a new publication is now available. It is the 'Evaluation Instruments for MBF 3C1 Mathematics of Personal Finance'. The cost of this publication is $10.00. Plans are in full swing for the GVMA sponsored OAME 2004 conference Thursday April 29 to Saturday, May 1, 2004. The theme is "Applications and Beyond". It will be held at the University of Waterloo. Residence space has been booked for those looking for an excellent deal on accommodations. Anyone who wishes to speak at this conference or be a volunteer should find a link on our web site : http://home.golden.net/~gvma.

ISOMA - Rep: TBA :People still required for the ISOMA Executive. Please contact Brian Raaflaub

MAC2 - Rep: Greg Clarke: The Mathematics Association of Cottage Country is in the process of finalizing details for their Fall Mini Conference. Check out our web site at http://smcdsb.on.ca/secondary/MAC2/

NOMA - Rep: Pauline Therrien: Both Judy Dussiaume and Pauline Therrien attended the TIPS for Math 7,8 and 9 Applied Inservice Session on September 11, 2003. It was an excellent opportunity to review the materials, their purpose and future planning for its implementation. Judy and Pauline attended the OMCA Meeting where reports were shared from the Ministry of Education, EQAO, TIPS,and from our own Judy Dussiaume's GSP demonstration!

NWOAME- Rep: Ann Kajander: After a lull in activity following our highly successful hosting of the Math Olympics in 2001, NWOAME is hosting a mini conference February 26 and 27 2004 at the Airlane Hotel in Thunder Bay, for regional Elementary and Secondary teachers. Invited speakers and grade specific workshops will be included in this event. Stewart Craven will be the Keynote speaker.

PRMA- Rep: Jacqueline Hill: PRMA is busy working on OMO 2004 and will have the forms and information ready for the next OAME meeting.

QSLMA-Rep:RobertSherk:

The QSLMA executive was active over the summer, putting together a program for our Fall mini conference. QSLMA sent a team to last June's OMO and a team is in place to organize a local event again next year.

SAME-Rep:SumintraKoowar: Please check OAME web site for more information on our SAME conference.

SWOAME- Rep: David Petro: SWOAME had some Geometer's Sketchpad and Fathom Workshops over the summer that brought in some new members. We hope to have some more workshops in the fall to also increase our membership. These may also include a dinner with a TBA guest speaker.

TEAMS- Rep: Pat Margerm:

TEAMS met in the fall to plan the annual miniconference and OMO event. A recent secondment to the Ministry has resulted in the need to elect a new president. TEAMS is planning to host the provincial OAME Annual Conference in 2005 and in preparation for this event TEAMS is still actively seeking volunteers and ideas. Please talk to your members about what they would like to see, hear and do at a conference and send us your suggestions.

WOMA - Rep: John Ferguson: Preliminary planning has been done for hosting a "Dinner and a Manipulative" series, similar to last year's. The next publication of the SinePost was out in November. .Under the direction of Tom Griffiths, the 2003 OAME/Union Gas OMO was a great success. A cheque representing the profit, has been forwarded to OAME. Our thanks go out to Marg Kemp for her many years of volunteering to run the local play downs for OMO. .

Y4MA - Rep: Rosey Mastrofrancesco: roseym5@rogers.com. We continue to update our web site and choose monthly winners to encourage membership within our area.

Closing Remarks

The skill - testing question is: Who is the new NCTM rep?

Yours in Mathematical fun

Jacqueline Hill



Ontario Association for Mathematics Education

PUBLICATIONS

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▲ ODE TO WORK

MIKE WHELAN
PAUL DWYER CHS, OSHAWA

Mike Whelan a teacher of Mathematics at Monsignor Paul Dwyer High School in Oshawa wrote this poem in response to a question about the development of the dot product of two vectors and how to describe to students the reason that vector multiplication would be defined in such a manner.

If you find, one fine day, you are looking for work
Because you were rudely displaced
Then find out how the force that caused you to move
To the locale your have now embraced.

There may be an angle between this great force
And the direction in which you are going
The magnitude of its power and the lengthof your trip
Are things you need to be knowing.

Work will be found if your reasoning is sound
And the product you get is much greater
Its just magnitude F time magnitude S
Multiplied by the COS θ

"Why the COS θ?", I now hear you cry
Then the obvious reason must hit you.
We, of course, must ensure, as OBI would say
That the force you employ must be with you.

Now apply this new product to any two vectors
Let's call them by names u and v.
Then the inner, the scalar, the dot v•u
Is defined with universality.

It is no longer work (in fact it is fun)
v•u is just multiplication
We define it that way (since it's useful, I say)
And there's no other deep explanation.

We multiply vectors in this rather strange way
Since we need (as all must) to find work.
But we'll do it again and quite differently too
When we run across something called Torque.

Mike Whelan
Paul Dwyer CHS, Oshawa

OAME Financial Statement 2003/02

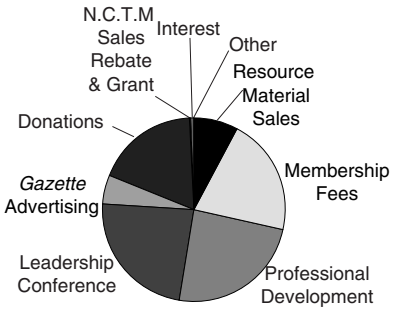
Notice to Readers

We have compiled the Balance Sheet of Ontario Association for Mathematics Education (Association Pour L'Enseignement Des Mathematiques) as at August 31, 2003 and the Statement of Operations and Operating Fund Balance for the year then ended from information provided by management. We have not audited reviewed or otherwise attempted to verify the accuracy or completeness of such information. Readers are cautioned that these statements may not be appropriate for their purposes.

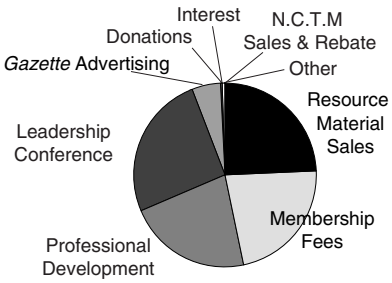
London, Canada September 13, 2003
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2003/2002

Revenue 2003 / 2002

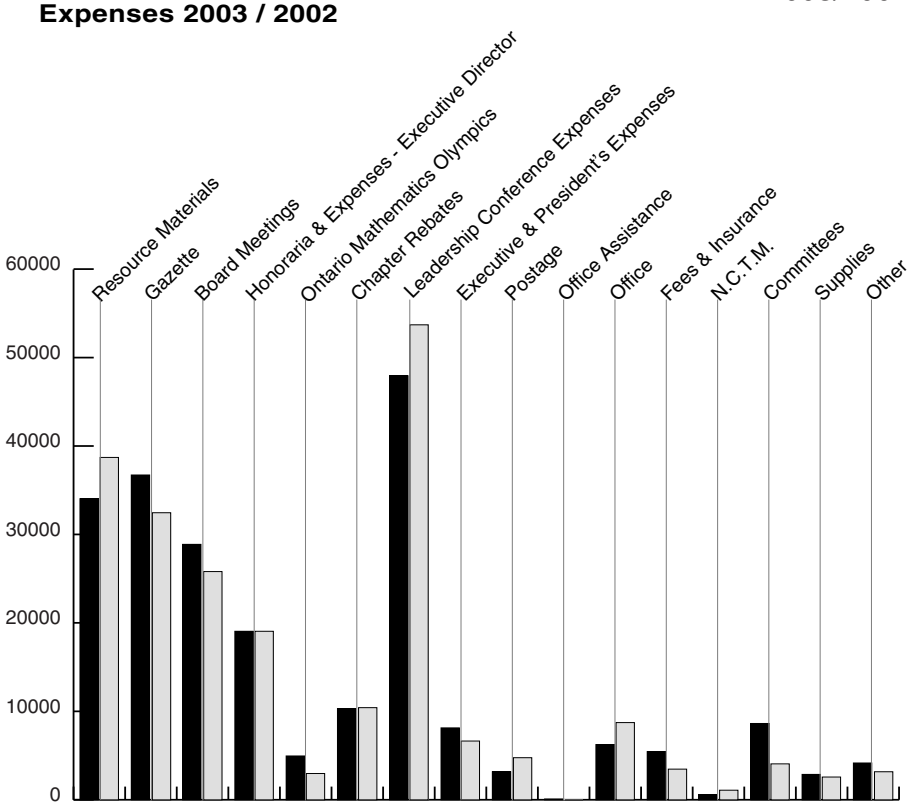


2003 ($228 921)

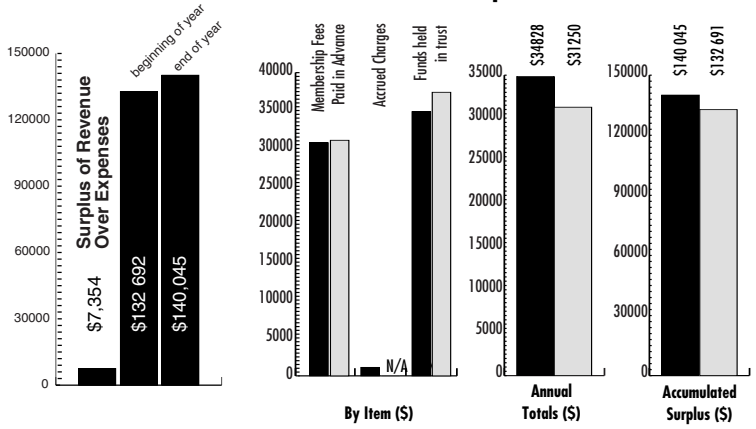


2002 ($237 434)

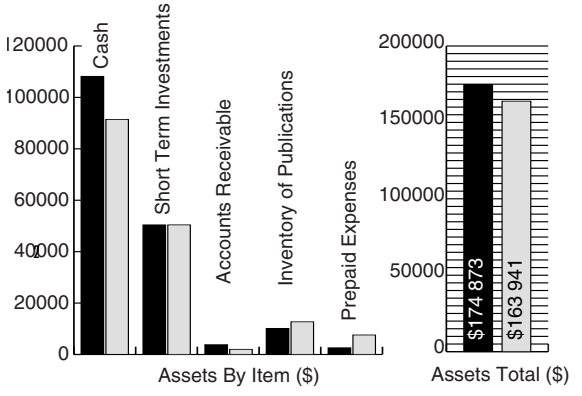
Expenses 2003 / 2002



Liabilities & Surplus 2003 / 2002



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▲ 2003-2004 OAME Board

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