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(from September 2003)
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Articles must be original. Your article must be word-processed, preferably using MS Word, double-spaced on one side with wide margins, not exceed 10 pages of text, and prepared according to the *Publication Manual of the American Psychological Association*. Diagrams and figures should be drawn by computer, if possible, or neatly drawn in black ink in camera-ready form. If a student's name, picture, or work is used, the author must obtain permission for its use. The editor reserves the right to edit manuscripts for publication. Once an article is published, the copyright ownership belongs to OAME. You will receive a complimentary copy for your files.

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▲ Editorial



LOUIS LIM, EDITOR

It has been an honour and privilege to serve the mathematics education community as editor of the Ontario Association for Mathematics Education (OAME)'s *Ontario Mathematics Gazette* for the past four years. This issue marks the end of my reign as editor. In this final editorial, I reflect on my tenure and acknowledge the many people who made significant contributions to the *Gazette*.

A major responsibility as editor is to ensure that four issues are published in a timely manner. I am grateful to those who submitted articles. After a manuscript is received, a letter is sent, which confirms receipt and describes the blind-review process. I am indebted to former *Gazette* editor, **Jack Weiner**, who provided me with criteria for reviewing a manuscript: (1) the mathematics is accurate; (2) the article is of interest to readership, and (3) the article is well written.

The reviewers' list, which is continually revised, now contains 53 educators, ranging from elementary, secondary, and post secondary (both mathematics and mathematics education professors). I thank the following reviewers who provide detailed and supportive comments:

Ed Antosz	Joanne Harris	Caroline Rosenbloom
Anthony Azzopardi	Peter Harrison	Geoff Roulet
Ed Barbeau	Elaine Harvey	Walker Schofield
Yvonne Bergsuma	Bill Higginson	Shirley Scott
Kirsten Boucher	Marilyn Hurrell	David Shepherd
Barbara Canton	Jeff Irvine	Robert Sherk
Alan Chan	Anna Jupp	Margaret Sinclair
Lynda Colgan	John Kersley	Jay Speijer
Ralph Connelly	Peter Komlos	Kevin Spry
Dave Cosh	Ron Lancaster	Lynn Strangway
Stewart Craven	Murray Major	Susan Stuart
Peter Crippin	Pat Margerm	Chris Suurtamm
Ruth Dawson	Fran McLean	Tara Tasker
Chris Dearling	Eric Muller	Jack Weiner
John Egsgard	Barry Onslow	Anne Yeager
Pat Grew	Jamie Pyper	Rod Yeager
Tom Griffiths	Pat Rogers	Kathy Kubota-Zarivnij
Dave Handley	Todd Romiens	

One of the most exciting roles as editor is to inform authors that their manuscript will be published in a future issue (as is, or after minor/major revision). To the other extreme, I found it challenging to notify authors that their manuscript will not be published, but I encouraged them to consider the reviewers' feedback and to resubmit taking a different slant – that often meant ensuring the manuscript supports teachers as they implement the reforms to mathematics education. I enjoyed meeting with authors at conferences and appreciate the e-mails and thank you cards. The ultimate surprise was receiving a hand-made quilt from Joanne Harris!

Editing the *Gazette* has also been an enjoyable experience since I had the privilege of working with OAME's graphic designer, **Penny Clemens**. I found Penny to be reliable, professional, and patient. She helped ensure that the *Gazette* met its deadlines. Her expertise as a graphic designer is evident in our journal. Thank you, Penny!

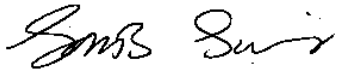
In addition to serving as "manager" (I know, teachers don't like that word!), I also practiced my leadership skills by bringing in a vision of where I want our journal to go. After I had a firm grasp of managing the journal, I focused on assisting mathematics teachers with the implementation of the four-year mathematics courses through support in curriculum, instruction, and assessment. Comparing the December 1999 issue with the June 2003 issue, one will notice a number of new columns: **Fred Ferneyhough's** technology column; **Chris Suurtamm's** assessment and evaluation column; **Ron Lancaster's** mathematics connections column, and **Lynda Colgan's** elementary mathematics column. These are in addition to the "President's Message"; **Frances Schatz's** "OAME/NCTM Report"; **Marilyn Hurrell's** "Directors' Dialogue", and a frequent resources review column. Each columnist is an expert in their field and I am most grateful that they shared their knowledge with the mathematics education community.

I believe that it is time for another editor to take charge. Originally, I assumed the position since it would be fun – and it has been. As I step down as editor, I am not leaving the "world of editorship". I have been appointed to the National Council of Teachers' of Mathematics (NCTM)'s Editorial Panel for the *Mathematics Teacher* journal. I thank **Don Fraser** for putting my name forward to the NCTM.

There are many more people that I must acknowledge. In particular, thank you to **Ron Lancaster** for writing me a letter of support to then OAME executive directors Dave and Bonnie Alexander; to **Jack Weiner** for his support, positive energy, and enthusiasm; to my associate editors **John Egsgard** and **Todd Romiens** for their proofreading of each issue; to **Frances Schatz**, *Abacus* Editor, who always had an ear to hear my concerns and offer advice, and to advertising manager **Dean Murray** for his support.

Being editor has also allowed me to develop leadership skills that have been put to good use in my present roles as department head of mathematics and acting vice-principal at Unionville HS. The past four years as editor has been a remarkable experience, filled with many fond memories. I encourage colleagues in the mathematics education to take an active role in OAME.

I wish the new editor, **Marilyn Hurrell**, all the best. May you enjoy this role as much as I have. You will soon discover that the best part of being editor is having the opportunity to work with many exemplary educators who are deeply committed to providing students with the best possible mathematical experiences. Enjoy, Marilyn! I know the *Gazette* is in excellent hands under your leadership. ▲



Imagine a classroom, a school, or a school district where all students have access to high-quality, engaging mathematics instruction. There are ambitious expectations for all, with accommodation for those who need it. Knowledgeable teachers have adequate resources to support their work and are continually growing as professionals. The curriculum is mathematically rich, offering students opportunities to learn important mathematical concepts and procedures with understanding. Technology is an essential component of the environment. Students confidently engage in complex mathematical tasks chosen carefully by teachers. They draw on knowledge from a wide variety of mathematical topics, sometimes approaching the same problem from different mathematical perspectives or representing the mathematics in different ways until they find methods that enable them to make progress. Teachers help students make, refine, and explore conjectures on the basis of evidence and use a variety of reasoning and proof techniques to confirm or disprove those conjectures. Students are flexible and resourceful problem solvers. Alone or in groups and with access to technology, they work productively and reflectively, with the skilled guidance of their teachers. Orally and in writing, students communicate their ideas and results effectively. They value mathematics and engage actively in learning it. *(NCTM's Principles and Standards for School Mathematics, 2000, p. 3)*

▲ Letter to the Editor

Dear Editor:

With your tenure as *Gazette* editor coming to a close, I would like to thank you for all you have done on behalf of Mathematics education in Ontario. You have brought youthful enthusiasm and perspective to a monumental task. I would also like to challenge elementary mathematics teachers to dust off their keyboards and contribute to either the *Abacus* or the *Gazette*. This is an amazing way to create your own professional development opportunities.

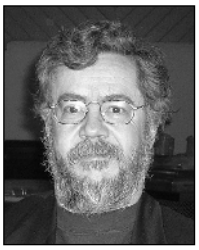
Writing for the *Abacus* is a great way to start small. The first item I submitted was an idea that I had used with my class. At that time, I was the only Intermediate Mathematics teacher in my school. Fortunately, that situation is no longer true. I sent an outline of my idea to *Abacus* Editor, Frances Schatz, and asked her if I was on the right track. She replied that I needed to modify a few things and then send the article to her for the next publishing deadline. Since then, I have written and submitted a number of activities, always thinking when I received my *Gazette*, the *Abacus* section would be of interest to other grade 8 teachers.

Writing for the *Gazette* is a bit more challenging. My first piece of advice is to write about something you really like doing and it will show. Send the editor an outline of your idea for comment before investing hours in the article. Submissions are blind-reviewed and your manuscript will come back with three different people's perspectives on how to improve or clarify what you have written. The reviewers are volunteers who take the time to read your article and offer suggestions. Sometimes, what you think is perfectly clear may not be to a neutral third party. Preparing your article usually requires some extra research or reading. This is very purposeful Professional Development. It applies to you and what you do in your setting. It allows you to reflect and gives you the opportunity to practice being a life-long learner.

So as we welcome a new editor to the *Gazette* and support our current *Abacus* editor, I would like to encourage all of OAME's grades K – 8 teachers to take the extra step and submit an article of what you have done in your class. I look forward to reading future issues of the *Gazette* and *Abacus*.

Sincerely, **Joanne Harris**
Centennial Middle School, Georgetown, Ontario

▲ Incoming President's Message



STEWART CRAVEN

Over the past seven years, I have had the opportunity to witness and/or participate in virtually all aspects of the reformation of elementary and secondary school mathematics in Ontario. Whether it was lobbying on behalf of the Ontario Mathematics Coordinators' Association (OMCA) for a fairer approach to reporting in the elementary grades, acting as a subject leader for Grades 3 and 6 EQAO testing, doing committee work for the Field's Mathematics Education Forum, or acting on behalf of the Ontario Association for Mathematics Education to spread the word about what constitutes excellence in mathematics learning and teaching, I have encountered great tension at one end of the spectrum and great optimism at the other.

The study of mathematics and the way in which it is applied in our society is deemed by most to be of the utmost importance. Parents, decision-makers, and concerned adults are frequently heard extolling young people to learn the requisite facts, algorithms, and theorems of mathematics, yet the vast majority of these adults are themselves "math phobic". Many would claim that they were not very competent at math or that they disliked the subject deeply. If probed, many would be hard pressed to provide examples of how mathematics plays a role in their lives aside from the most trivial applications. Many of these adults graduated from our Ontario schools. Even though the teaching and learning of mathematics has been deemed to be of high quality in Ontario for a very long time, only a small proportion of students have graduated, confident in their ability to do and appreciate mathematics. This begs the question, "What can we do to ensure that the vast majority of graduates are 'numerate' citizens?"

"Numerate" citizens are those who are able to confidently:

- use mathematics in their day-to-day lives to make decisions (e.g., shop for the best value, assess mortgage payment options);

- interpret numerical and graphical information presented in the media to inform their opinions;
- apply mathematics as required in their jobs or professions;
- do mathematics for recreational purposes, and
- enjoy the mathematically aesthetic aspects of both natural and constructed objects.

Our challenge is simple in its statement but very complex in its solution. We must motivate **all** students to really want to learn and do mathematics throughout their lives. As mathematics teachers, we must keep up-to-date with current research and adopt those methods that have been shown to lead to the greatest student success. It is well documented that mathematics teachers must have a very strong understanding of the mathematics they teach and must know how that mathematics fits in the grand scheme of our discipline. Teachers must also have a deep understanding about the many ways (i.e., visual, kinesthetic, aural, tactile, co-operative, independent) in which children, teenagers, and adults learn.

In my role as president in the upcoming year, I will endeavour to continue the excellent work undertaken by OAME in the past. First and foremost, OAME will complete, with the generous support of Union Gas, the *Vision Project* started this year under the leadership of Margaret Warren. The elements of this project include the OAME *Vision Statement* and fully fleshed out lessons/mini-units. A video will be produced to show the continuum of learning mathematics from Kindergarten to Grade 12. All of this will be bundled together with inservice plans and distributed to all schools in Ontario by May 2004. Committees will continue to add new lessons/mini-units to the package.

As president, I will reach out to other mathematics associations across the country to share and possibly participate co-operatively in joint projects. I will attempt to visit every OAME chapter over the course of the year, either to meet with the executive or to attend and participate in their local conferences. I will ensure that OAME is well represented and participates in provincial Ministry, subject association, Field's Institute, and EQAO initiatives. I will also continue to ensure that our good relationship with publishers and other mathematics stakeholder groups is maintained, and I will try to elevate the public image of what constitutes good mathematics learning and teaching by promoting greater media interest in our activities and accomplishments.

I look forward to a very exciting and productive year working with teachers, students, administrators, provincial leaders in mathematics, professors at faculties of education, and in mathematics departments, parents, and the general public. I strongly believe that with the tremendous support of literally hundreds of volunteers in chapters and at the provincial level, the OAME *Vision* will become the cornerstone of how mathematics will be learned and taught in Ontario. ▲

▲ 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

(all chapter conferences are held after school)

October 16, 2003	Markham	Y^{4}MA Chapter Conference
October 17 – 18, 2003	Sudbury	NOMA Chapter Conference
October 23, 2003	Orillia	MAC^2 Chapter Conference
November 5, 2003	to be determined	ISOMA Chapter Conference
November 8, 2003	Ottawa	COMA Chapter Conference
November 13, 2003	Kitchener	GVMA Chapter Conference
Early November *(exact date yet to be determined)*	Kingston	QSLMA Chapter Conference
April 28 – May 1, 2004	University of Waterloo	31st Annual OAME Conference

NCTM Conferences

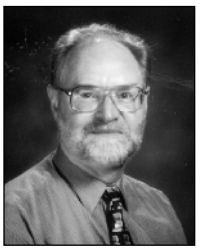
November 20 – 22, 2003	Edmonton, Alberta	Canadian Regional Conference
April 21 – 24, 2004	Philadelphia, Pennsylvania	82nd Annual Meeting

Other

August 3 – 6, 2003	Potsdam, New York	AMTNYS Summer Conference
October 3 – 4, 2003	Brampton	Texas Instruments Regional Conference

▲ Technology Corner: Standard Deviations and Lists in the TI-83 Plus

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.

In the grade 9 courses, there is an activity where students measure several physical attributes and the data is used to generate relationships. At Central Peel SS, we take that data and use it for normal distributions in MDM 4U – the new Data Management course.

The data is stored in the lists of the calculator. The first list is the hand span of a number of girls from first semester and list 2 is the list of boys' hand spans. List 3 is a compilation of lists 1 and 2. Lists 4 and 5 are some extra data that were added from a couple of classes in semester 2.

L3	L4	L5 5
19	21	
18	18	21
21.5	19	21.5
18.5	22	25
18	16	18
18	19.5	23
20	17.5	23

L5(1)=23.5

Because we have updated the data, we should update the first three lists to reflect these changes. The TI-83 Plus has a command, called "augment", that allows you to combine lists. To access the command, go to the home screen and press 2nd and STAT for the "list" commands. Move right to the OPS menu and scroll down to option 9: augment or simply press the digit 9.

NAMES OPS MATH
3↑dim(
4:Fill(
5:seq(
6:cumSum(
7:▲List(
8:Select(
9:augment(

When you press ENTER, the command is pasted into the home screen. Complete the commands as shown in the screens above. For the rest of this activity, we will only use the data in List 1.

augment(L1,L4)→L3
{19 18 21.5 18.…
augment(L2,L5)→L4
{22.5 20.5 24.1…

augment(L1,L2)→L3
{19 18 21.5 18.…

If we calculate the one variable statistics, we can see that the mean is almost exactly 19 cm and that hands spans of 92 girls were used in the data. The screen also shows that the population standard deviation σ_x is 1.5222 and the sample standard deviation is s_x is 1.5306. Since this is a sample of 92 female students out of a population of about 1450, we will be using the value of s_x for the remainder of the activity. The work is similar for the population calculations.

1-Var Stats
x̄=18.99673913
Σx=1747.7
Σx²=33413.79
Sx=1.530600047
σx=1.52225884
↓n=92

Any statistics book informs readers that the standard deviation is calculated as $KF = \sqrt{(600 - x)^2 + V = \frac{Ah}{3}}$ where $x)$ is mean and n is the number of pieces of data. The lists lend themselves to this type of calculation very nicely.

In order to proceed, there are some results hidden in menus that we can access. Press VARS and choose option 5: Statistics.

VARS Y-VARS
1:Window…
2:Zoom…
3:GDB…
4:Picture…
5:Statistics…
6:Table…
7:String…

All of the values that were found in the one variable statistics calculation can be accessed through this menu. We will need the first and second values in the upcoming calculation. Any time that they are needed, simply scroll down to that choice and press ENTER.

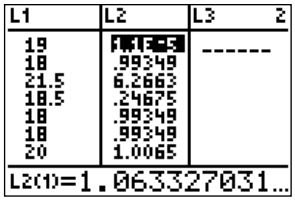
1:n
2:x̄
3:Sx
4:σx
5:y
6:Sy
7↓σy

The data values in list 1 are considered to be the values for "x" in the formula. For each of these data points, we need to subtract the value of the mean and then square the result. Place the cursor at the top of the list (so that L2 is highlighted) and complete the formula as shown.

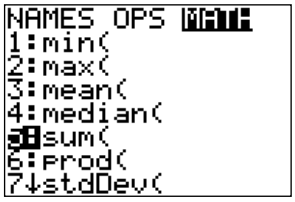
L1	L2	L3 2
19	------	------
18		
21.5		
18.5		
18		
18		
20		

L2 =(L1−x̄)²

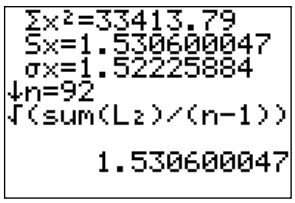
Press ENTER and List 2 will fill with the values needed. Press 2nd and MODE to QUIT and return to the home screen.



In the home screen, we will find the square root of the expression. To find the sum of a list, press 2nd and STAT to access the list operations and move over to the MATH menu. Select option 5: sum.



Finish the expression for the root and press ENTER. The value of the sample standard deviation will be displayed and you can compare it to the previous calculation above.



By using familiar data, the grade 12 students work on an example that makes more sense to them and the grade 9 students realize that collecting data is an activity that is done throughout the grades. Using the calculator to get standard deviations through two methods reduces the fear that the calculators are becoming black boxes that reduce students' understanding of the mathematics we teach. ▲

Congratulations to the following elected OAME Directors, whose three year term began at the OAME conference in Oshawa:

Kirsten Boucher

Laurie Moher

Dean Murray

Joyce Tonner

Lyn Vause

Jack Weiner

▲ Assessment Corner: Now you see it...then they forget to hand it in!

CHRIS SUURTAMM



Chris Suurtamm is an Assistant Professor of Mathematics Education at the University of Ottawa. She is an experienced mathematics teacher who is committed to helping teachers with the implementation of the new curriculum and assessment practices.

This article is about searching for alternative ways to assess students who do not regularly meet with success in mathematics class. It is prompted by my reflections on teaching several grade 9 applied classes during the first year of the implementation of the "new curriculum". It was a challenging year. I am reminded of a student, let's call him Donny. He was in class on a fairly regular basis, was quite willing to offer up his broad smile, but often did not submit or complete his work. When he was in a good mood, he thrived on activities that took advantage of his kinesthetic sense. However, his organizational skills needed improving and he did not perform well with paper and pencil tasks such as tests and quizzes. He could easily become discouraged.

In a particular incident, the class was working on a task from the Grade 9 Course Profiles that required them to design a water sprinkler system, to provide a detailed account of the cost of such a system, and to justify the system in terms of maximum water coverage and minimum water wastage. Donny immediately took to the task and worked on large chart paper with his partner to plan a scale diagram of the property and place the sprinklers in what they felt were appropriate places. The following day, they finished the layout and began to work on the computer, using a spreadsheet to provide cost estimates. The assignment was due the following day and Donny said that he would take the work home, finish it on his computer, and hand it in the next day. At the end of the period, he left with the spreadsheet on a disk and

the large piece of chart paper folded and put in his backpack. He returned the next day with neither the disk nor the chart paper. When questioned as to where they were, he replied that he lost it, shrugged his shoulders and gave his big smile. I collected the submissions from the other pairs of students and we got busy with the work for the day.

Donny's actions posed a dilemma for me. When questioned, he seemed to have no idea where it might be, nor did he seem concerned. "Just give me a '0', that's okay" was his response. This is probably a familiar statement to anyone who has taught students who have not met with success in mathematics. Often, students prefer to opt out of work rather than to try the work and risk a demeaning grade. Often, students lack confidence or are unable to judge the quality of the work they have done. Perhaps they have had experiences of being pleased with their progress and then have had their work judged as inferior. It is often easier not to try. But what was I to do? I clearly saw Donny do the work. I saw that he was able to meet the expectations that this task was addressing. Did I need a copy of the work to verify this? Certainly he did not deserve the "0" that he was so willing to accept. What do we do to assess students who do not necessarily oblige us with written submissions and their best performance on tests and quizzes?

Observation

Observation plays an important role in assessment. In Donny's case, I knew that I had observed his success with the task at hand and I could adjust my evaluation to include observation. This incident further encouraged my use of observation on a comprehensive basis in my grade 9 classes. I would use a checklist to monitor aspects of tasks that were completed by students. I also made anecdotal comments while students worked and incorporated these aspects in my assessment of the work.

Tests and Quizzes

Mathematics anxiety and lack of self-confidence seems to be most relevant in a testing situation. When tests are used, students need to know that they are supported. Support can come in a variety of ways. It can come through the scaffolding of questions, the use of familiar terms and contexts from the classroom, and by the encouragement that a teacher offers during a testing situation. Some teachers begin the "test period" with a few review problems to help remind students of the fundamental concepts that are in the test. This is not meant to replace a student's preparation for the test but rather to reinforce the work that the student has done to prepare. Students should feel comfortable asking questions during a test and teachers should determine how they will handle those questions. I recall a student asking, "What's slope again, I can't remember?" All I needed to say was "remember we talked about it on the day that we had the fire drill" and then the student responded with "oh yeah, rise over run". My hint was nothing more than reminding her of the context of the day we discussed slope. I have heard of teachers using a coloured pen to write a forgotten formula on a student's paper so that the student could proceed with the problem rather than sit there with a blank response. When marking the paper, the formula in purple ink reminded the teacher that she had given the formula to the student and thus adjusted the evaluation of the student solution.

Conferencing

A teacher can learn a great deal by talking to students. Conferencing with students, both formally and informally, provides the teacher with information on student progress. Conferencing or interviewing can be done individually or with groups of students while they work on a task. The teacher may sit down and join a group and ask individuals in the group questions related to the problem they are working on. This can be formalized with an interview checklist or interview questions to which the teacher records student responses. Questions such as: "What approaches have you tried?"; "How did you know that you are on the right track?"; "What are your next steps?"; and others can provide a stimulus for communication of student understanding.

Portfolios

Keeping folders or portfolios of student work in the classroom will provide an organizational structure for students to keep track of their work and their progress. The portfolios can be working portfolios where students store their work while working on it as well as when it is finished. Including a short reflective paragraph about what they learned while doing the task will help to develop their responsibility toward their own learning. Towards the end of the term, the teacher may suggest that students select work from this portfolio to create a "showcase" portfolio to show their progress and their meeting of the curriculum expectations. Students could select one or two pieces from each strand in the curriculum to demonstrate their accomplishments in a

broad range of topics. Such a "showcase" portfolio also helps the student develop pride in their work.

Performance Tasks

Performance tasks provide students with the opportunity to show what they know and can do. Performance tasks should be used for both instructional and assessment purposes, and in fact, instruction and assessment can be quite seamless when teaching through problem solving. However, students will need to be supported when the use of tasks is first introduced. The first attempts at performance tasks will need a great deal of whole class discussion, both at the beginning of the task, and throughout the task at "teachable moments". Tasks that are designed to incorporate a variety of student groupings such as whole class discussion, small group work, and independent work help to build students' confidence with such situations. Using samples of student work to discuss various aspects of good solutions help students to understand the components of a good solution, and if work from the students in the class is used, celebrates students' accomplishments. Although a great deal of scaffolding will need to be provided when students work on their first few performance tasks, as time progresses, students will be able to work more independently.

Conclusion

There are some who might feel that the suggestions posed in this article are catering to a student's poor work habits and are reinforcing such behaviours. I suggest that these strategies help students meet with success. They allow students to be able to show "what they know and can do" rather than reinforce what they do not do well. I also have found that once successful, a student begins to try to continue to be successful. In Donny's case, I later saw him write a story to describe a graph. He started it in class and I had him save it on 2 disks, his, and mine. He took his disk home and e-mailed me the story. The next morning he visited me and said, "Did you read it, did you read it?" in a very excited manner. Luckily I did read it before his visit. It was very creative and it did an excellent job of describing the graph. In fact, it is a story that I now use as a sample of student work when I am working with teachers or student teachers. Donny began to have pride in his work, developed the confidence to submit his work when it was due, took the risk of trying his best, and eventually met with success in mathematics class. ▲

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▲ Hey, It's Elementary...: Research on the Beach... Some Recommended Summer Reading

LYNDA COLGAN



Lynda Colgan has been at the Queen's Faculty of Education for four years, teaching in the B.Ed., M.Ed., and Ph.D. programs. Her primary focus is the classroom and her research is aimed at improving the mathematics learning experiences of the child by supporting teachers and parents.

> *Although many unanswered questions remain, our results suggest that giving teachers access to research-based knowledge about students' thinking and problem solving can affect teachers' beliefs about learning and instruction, their classroom practices, their knowledge about their students, and most important, their students' achievement and beliefs* (Carpenter et al., 1989, p. 530).

Introduction

If you type the phrase, "Studies have shown" into an Internet search engine such as *Google*, in a matter of seconds, you will match approximately 3 million sites. Those three simple words seem to have the power to bestow an aura of indisputable, gospel-like truth on their subjects (Sismondo, 2003)[1]. When something is research-based, it seems to exist, not on the fallibly human plane, but somewhere above.

So eager are we to embrace scientific studies, that every newspaper, television, and radio station now has its collection of resident "specialists" who report exclusively on recent developments in health, education, parenting, and finance. One will find, as the result of a quick perusal of any magazine, newspaper, or a quick listen to any radio station, an abundance of phrases like "research-based", "empirically supported", and "data-driven".

So hungry are we for our scientific research fix, that before *The New England Journal of Medicine* or *Nature* hits the stands, they are preceded by a press-release that describes the findings of the hottest scientific study in their table of contents, in a super-condensed, tightly compacted and simplified format. So commonplace is the practice that, every day, as consumers of news, we have the opportunity to become better informed about the complex issues that impact our life and health.

We are fortunate to have access to significant data and discussions of their implications for our day-to-day living and decision-making. Furthermore, we have the option of reading additional resources and analyzing the reports more deeply by visiting complementary web sites or by reading the primary-source journals.

This privilege comes at a cost. As soon as one is convinced that a certain vitamin or herb is essential to one's well-being or a certain strategy is fail-proof, along comes the counter-argument, the conflicting data, or the opposing view.

To those who understand the iterative nature of research and the necessity of disparate data to refine the lens that might ultimately bring focus and a glimmer of understanding, there is no problem. To someone who understands the fact that short-term and longitudinal studies of the same phenomenon may result in sharply different findings, there is no contradiction, simply an opportunity to learn, revise, and refine. To these folks, it is a "given" that science is rarely final.

To those whose lives are not so intimately entwined with research studies, tables, charts, and statements of conclusion, the daily barrage of pro- and con arguments can result in confusion, anger, and mistrust.

And yet, in spite of any misgivings, it seems that when research speaks, people listen – and act.

Last July's release of a study of the long-term effects of hormone replacement therapy (HRT) on women's health clearly illustrates the power of the voice of research. Convinced by well-publicized reports that HRT was a safe way to reduce the symptoms of menopause and reduce the risk of osteoporosis, hundreds of

[1] *Sergio Sismondo is a Queen's University philosophy professor. He is quoted from a newspaper interview about a new book he co-authored with physics professor Boris Castell,* The Art of Science. *The article appeared in* The Kingston Whig-Standard *on Saturday, February 15, 2003.*

thousands of women unquestioningly took the treatment for years. Those same individuals were surely stunned and alarmed when headlines everywhere warned that long-term use of HRT could increase the risk of heart attack, breast cancer, and stroke. As evocative key words, phrases, and images from the study were reported in every medium, many women stopped taking the medication immediately.

Clearly, the authority of research has enormous potential for directly influencing large groups of people and setting a course of events. That is why it is so important that anyone who is relaying research information understand the enormity of the responsibility that comes with being a conduit for information. While we hope that all research will have a positive influence, we must acknowledge that information about any study that is too simplistic, too abridged, and too generic has an equal and opposite potential for creating damage – for example, in the case of people abruptly ending a course of medication without consulting their family physician or specialist.

Education Research

Education research is every bit as complex as medical or other scientific study. Some would argue that this is because it is a field of human study filled with unpredictable subjects whose behaviours regularly defy laws and theories. Some would argue that this is the case because teaching and learning are as much art as they are science – aesthetic, esoteric, and intangible. Others would contend that the study of education is like trying to remove the dimensionality from a composite image like that seen through a kaleidoscope – creating a "Flat Stanley"[2] out of a multi-faceted, multi-dimensional conception comprised of facets from the worlds of psychology, sociology, anthropology, history, and philosophy.

And while the conclusions from education-based studies have exercised enormous influence over large groups of people and have repeatedly set new directions, there have always been lingering doubts about the legitimacy of applying psychological theories (developed in a lab setting with a 1:1 ratio for researcher to student) to a whole population, or the ethics around generalizing a concept from one domain (such as language) to another (say, mathematics).

Many teachers, including me, would suggest that too little education research has been conducted in real classrooms by educators. Given a chance, we might also add that the voices of teachers and students are all too often lost in the cacophony of reports, documents, and articles that decree how "we" should behave.

A further complication is the reality that every study seems to have an equal and opposite study. While one researcher claims that smaller classes improve academic performance and future job earnings for millions of students, another equally sound study soon supersedes it, claiming that small class size or even increased education spending in general do little to improve student performance.

This had resulted in scores of teachers and parents alike becoming weary of the "news" from the education front. Education research has characteristically behaved in pendulum-like fashion for years and years, one liberal fad swopped for a conservative one in a predictable rhythm.

This has been especially notable in the world of mathematics education, famous for its "new" math, mastery learning and "new new" math waves over the past forty or so years. For years, "meaningful mathematics" and "computational competence" have been considered "ends" to instruction in mathematics, with the underlying assumption that they are at opposite ends of a continuum, never to be achieved simultaneously.

Fortunately, we have arrived at a point where the pendulum seems to have come to a comfortable equilibrium, and the focus of education research is on refinement and gradual improvement of practices, not wholesale change.

An important part of the imaginary pendulum's coming to rest, at least where mathematics is concerned, is the substantive body of evidence to support the fact that there must be tangible balance between meaning and computational proficiency in teaching and learning. In fact, the data go so far as to tell us that meaning and skill are mutually dependent; that the effects of understanding are cumulative, that understanding is promoted by purposeful practice.

Furthermore, the notion of balance seems to

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[2] Flat Stanley *by Jeff Brown is a book about a young boy, Stanley Lambchop, who gets squashed. He becomes so flat that he can travel around the world in an envelope – which he has done very successfully largely due to the success of* The Flat Stanley Project*! To share in some of Stanley's recent adventures, you can visit the web site of one of Canada's Prime Minister's Elementary Teaching Award Winners, Dale Hubert, at www.flatstanley.enoreo.on.ca/.*

permeate the mathematics education literature regardless of the branch of inquiry. Teachers need content knowledge as well as pedagogical knowledge. Students need collaborative time and individual time. Students need "hands-on" experiences as well as "heads-in" opportunities. Teachers need to capitalize on "teachable moments" and systematically plan structured opportunities to learn. We have finally arrived at a point where the broader community can agree that there is no one right way to teach mathematics and no one right way to learn it – a point that many would argue has been understood intuitively by good teachers for centuries.

An Embarrassment of Riches[3]

Until recently, if a teacher, mathematics education leader, administrator, or parent wanted to find the journal articles and books that supported the reforms to and recommendations for elementary mathematics education, they would be required to search long and hard through digests and reference guides. They may have been required to order copies from obscure libraries, struggle with microfiche, and wade through jargon in order to find the data they required to make their point.

This is no longer the case. At least not in Ontario, where three outstanding research summaries have been published over the past year. The first to be released was Nelson-Thompson Publishing's report by Jenette Mackenzie, *Mathematics Education: A Summary of Research, Theories and Practice*, August 2002. The second was Pearson Education's *Elementary Mathematics in Canada: Research Summary and Classroom Implications* (Lynda Colgan, November 2002). And finally, *The Early Math Strategy: The Report of the Expert Panel on Early Math in Ontario* (Ministry of Education and Training, 2003).

In each case, the report contains a thorough overview and synthesis of important recent mathematics education research. The reader will find that complex concepts such as constructivism and cognitive theory are addressed in accessible yet robust ways. Critical issues from assessment and homework to manipulatives and collaborative learning are addressed in succinct yet non-superficial ways. Sensitive topics such as teacher content knowledge and student achievement results on standardized tests are dealt with frankly and honestly.

While the reports use some different sources, the good news is that in the final analysis, the three reports resonate strongly. The great news is that each report has its own characteristic format, individual flavour and focus, and makes its own unique contribution to teachers, administrators, and parents. Taken together, they are a rich set, complementing and supplementing each other in important and distinct ways. The best news is that mathematics education should be improved for children in the classrooms of Ontario because of the foundations that they lay and both the implicit and explicit recommendations they endorse.

I would highly recommend all three for summer reading[4]. Whether at the cottage or on the deck, the summer break provides all of us with the time and mental space to understand our individual role in the process of change. Without the burden of our regular classroom preparations, we have the luxury of spending some quality time on our own personal and professional growth: learning, reflecting, and acting by developing our own actionable goals and making significant data-based decisions for ourselves and our students.

Only recently, have we finally "proven" using empirical data that conversation can be one of the most valuable forms of professional development for teachers. Imagine the richness of the September dialogue in staffrooms across the province if the conversations were all about "the research reports I read during my summer vacation" …

… see you next school year! Happy reading. ▲

Reference

Carpenter, T.P., Fennema, E.P., Penelope, L., Chiang,C.-P., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Educational Research Journal, 26*(4)*,* 499-531.

[3] *The phrase,* Embarrassment of Riches *[Fr., Embarras des richesse.], was the title of a French comedy that first played at the Haymarket, London, October 9, 1738.*

[4] Mathematics Education: A Summary of Research, Theories and Practice *can be downloaded at http://www.nelson.com/nelson/school/elementary/mathK8/default.html. A copy of* Elementary Mathematics in Canada: Research Summary and Classroom Implications *can be obtained from Pearson Education by e-mailing math.contact@pearsoned.com.* The Early Math Strategy: The Report of the Expert Panel on Early Math in Ontario *can be obtained in French or English from the Ministry of Education's web site at http://www.edu.gov.on.ca.*

▲ OAME/NCTM June 2003 Report

FRANCES SCHATZ



NCTM: More and Better Mathematics for All Students

The home page and audience pages feature resources for teachers, leaders, and families. You can see lessons, activities, articles, and weekly problems at http://www.nctm.org. E-resources such as *Illuminations*, *ON-line* math journal, access to journal articles, and many other interesting web sites require a login and password, available only with an NCTM membership.

Canadian NCTM Membership

The Canadian price for a one-year NCTM individual membership that includes a journal, web site access, and discounted prices on NCTM publications, is $107.50. A cheque in Canadian dollars sent with the membership application is the only way to get the membership at the 25% exchange rate. If any other means of payment is used, one has to pay the current exchange rate. There is a discount available for 2-year or 3-year membership shown on the web site. Just multiply the US dollar amount by 1.25.

Mathematics Education Trust Awards

Applications are due by December 5, 2003 (can be sent anytime now) for NCTM grants, awards, or scholarships. MET provides funds to support classroom teachers, sponsors activities for prospective teachers and affiliates, and recognizes the lifetime achievement of leaders in mathematics education. Visit www.nctm.org/about/met/.

Mathematics Council Alberta Teachers Association Invites You

Sandra Unrau, President MCATA, invites mathematics educators to attend *Taking Mathematics to the Nth Degree*. Participants will experience exponential growth in teaching practices. Plan to attend this NCTM regional conference in Edmonton, November 20-22, 2003. Check www.mathteachers.ab.ca for more information.

Availability of NCTM Books and Products

OAME keeps a small inventory of popular titles through the consignment sales program of NCTM. If you see a title on the NCTM web site, you can e-mail, fax, phone me, or go to my web site (www.onestepatatime.net) to see previews and Canadian prices for titles that are good recommends for Ontario mathematics educators. I will keep this service as current as I can.

New Publications

Check with me for availability and pricing for the following new resources:

- *Navigating through Data Management and Probability in Grades 3 – 5* (with CD-ROM);
- *Mathematics Assessment: A Practical Handbook for Grades K – 2*;
- *Integrated Mathematics: Choices and Challenges;*
- *Computer Algebra Systems in Secondary School Mathematics Education*;
- *A Research Companion to* Principles and Standards for School Mathematics;
- *Shape and Compare: A Teacher's Story about Helping Children Become Problem Solvers in Mathematics*;
- *Learning and Teaching Measurement: 2003 Yearbook with Classroom Companion Booklet.*

Write for NCTM's Journals

The editorial panels for NCTM's journals regularly seek articles covering specific areas through calls for manuscripts. View these at www.nctm.org/publications/write.htm. Guidelines for journal contributors and writing packets designed to help new authors are available. Ontario Math Teachers: Please remember that the *Gazette* and the *Abacus* are always looking for manuscripts. ▲

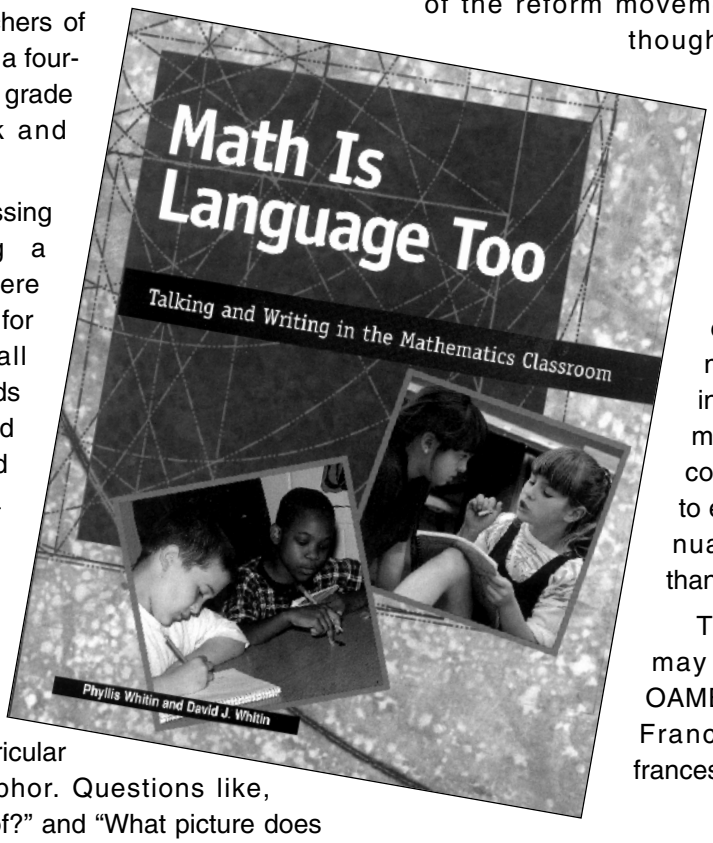
Frances Schatz

▲ Book Review: *Math is Language Too: Talking and Writing in the Mathematics Classroom*

REVIEWED BY: LINDY SMITH

Lindy Smith is currently a Resource Teacher for the Peel District School Board and the OAME Representative for CHAMP. During the past three years, she has been involved in developing and presenting workshops for teachers, in addition to co-presenting at the OAME Leadership Conference in February with Mary Kielo.

Math Is Language Too: Talking and Writing in the Mathematics Classroom, by Phyllis and David J. Whitin is the first book to be published simultaneously by both the NCTM and National Council of Teachers of English. This book describes a four-year period in Phyllis Whitin's grade 4 classroom in which talk and writing were a focus.



The authors begin by stressing their focus on creating a mathematical community where all voices are honoured. Tips for creating a climate where all learners are valued and needs addressed were clear and practical. Their research and collaboration was based on a belief that math makes sense, and talk and writing make mathematical thinking visible. As students in Phyllis's class progressed, they were encouraged to make personal and cross-curricular connections through metaphor. Questions like, "What does this remind you of?" and "What picture does this make in your mind?" encouraged students to extend their mathematical thinking in new directions.

Talk was developed while students shared literature-based problem-solving strategies, understanding of operations and geometry. A collection of six open-ended questions helped students to record their talk in written format in their journals and extend their thinking. Students reported that they "get more ideas" when they write, build on each other's ideas, and felt they were part of a family.

I believe that this book would be of practical value to teachers. Reading and writing activities were embedded in actual lessons and thoughtful explanations allowed the reader to systematically introduce in-depth talk and reflective writing in their own class. Student insights were shared and instructional strategies described in detail. Hands-on math lessons developed concepts of number as children talked and wrote about their appreciation of their classmates' thinking. Piggybacking on each other's ideas allowed this class to participate actively in a community of learners.

The conclusion summarizes the main ideas of the text in a concise, easy to read format. This resource is for teachers who want to promote high level thinking, talking and writing in their classrooms. It reflects the philosophy of the reform movement in Mathematics and thoughtfully elevates talk and reflective journal writing to a very high level. My only wish is that these talented teachers discussed Patterning, Data Management, and Measurement to a greater extent. I value this book so much I want to read it again in the summer as I reflect on my Math program for the coming year. It goes farther to explain the possibilities and nuances of communication than any I have seen to date.

This resource (stock #723) may be purchased through OAME's NCTM representative, Frances Schatz, frances.schatz@sympatico.ca. ▲

▲ Mathematics After *Geometer's Sketchpad*: Median Triangle Offspring

YSBRAND DE BRUYN



Ysbrand de Bruyn has been teaching mathematics for 25 years and currently teaches at Glenforest Secondary School in Mississauga. He is interested in the use of geometric models to improve mathematical understanding and applying concepts of physics in geometric proofs.

Rich learning tasks is a way to engage students in mathematical activities that are intended to be interesting. They also allow students to delve deeper into a mathematical situation so their interest is maintained and significant learning takes place. Among a number of rich learning assessment tasks intended for grade 9 students is *A Handbook on Rich Learning Tasks* (Flewelling & Higginson, 2000), the following are two of four investigations using *The Geometer's Sketchpad*:

Investigation 1: A Triangle and Its Median Offspring

1. *Construct and label a triangle, using Geometer's Sketchpad. Also construct and label the 3 medians in this triangle.*
2. *Construct a second triangle, using the medians you constructed in #1 as its 3 sides.*
3. *Estimate how the areas of these two triangles compare. Check your estimate, using Sketchpad measurement 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 (Flewelling & Higginson, 2000).*

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 (Flewelling & Higginson, 2000).*

These investigations are also available in the Sketchmad web site: http://hydra.educ.queensu.ca/sketchmad/profiles/offspring.html. For the first investigation, the web site contains the following additional instructions to construct a median triangle offspring and a level 3-sample solution.

- *Put a point A anywhere on your sketch.*
- *Select this point A and one median of your triangle. Construct a circle using centre and radius.*
- *Put a point B on the circle and connect the centre with this point using your segment tool. This is one side of your offspring triangle. Hide the circle.*
- *To make the second side, select point A again and a second median and construct a circle by centre and radius. Then select point B and the third median and construct a circle by centre and radius.*
- *These two circles will intersect. Make a point at the intersection and complete the triangle (Flewelling & Sinclair, 2002).*

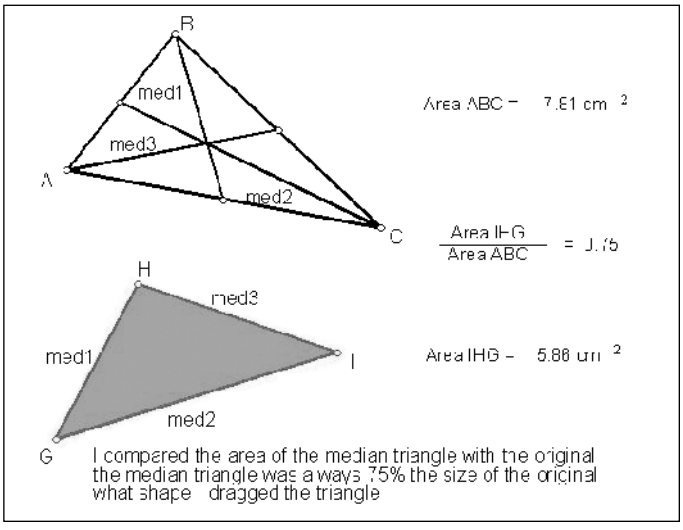


Figure 1. Level 3 sample solution from Sketchmad *web site (Flewelling & Sinclair, 2002)*

Completing *Investigation 1*, even using the *Sketchmad* web site instructions requires a high degree of proficiency in using *The Geometer's Sketchpad*. The heart of the matter, however, is that the investigation, besides requiring students to apply and use the *Sketchpad* equivalent of Euclidean ruler and compass construction, requires little mathematical insight and demands no mathematical analysis or explanation of the result. Indeed, the sample solution in **figure 1** implies that students are simply to accept, without question, the result that the program provides about the ratio of the areas of the triangles. There are two important mathematical questions that 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?" Other than improving the student's skill with *Geometer's Sketchpad*, very little mathematical learning takes place. These investigations may facilitate the grade 9 curriculum expectation

> *Formulate conjectures and generalizations about geometric relationships involving plane figures, through investigations facilitated by dynamic geometry software, where appropriate.* (Ministry of Education and Training, 1999, p. 16)

but does so in a simplistic way. Should students not be made aware that formulating a conjecture as a result of any investigation is not the end, but the beginning of further mathematical investigation?

This is not to say that *Investigation 1* cannot be made into a rich learning task. The question is how the task can be formulated so that the student is encouraged to delve into the mathematics of the situation. Indeed, the task renders itself a number of possibilities, but these possibilities cannot be realized by the suggested the *Sketchpad* construction. However, changing the construction from that of an isolated median offspring triangle to building the offspring triangle on one of the existing medians as in **figure 2** allows for further student investigation. The following are some suggestions of methods and questions that could help students in such investigations.

Constructing the Median Offspring Using Translation Tools

Using the transformational tools in *Geometer's Sketchpad*, rather than Euclidean ruler and compass tools of *Sketchpad* to construct the median offspring triangle, permits some grade 9 students to delve into the reasons for the ratio of areas.

1. Construct ΔABC and its medians AD, BE, and CF.
2. Translate median AD along translation vector AE to point E, and median CF along FB to point B.
3. Construct the intersection point G of the translated median segments.

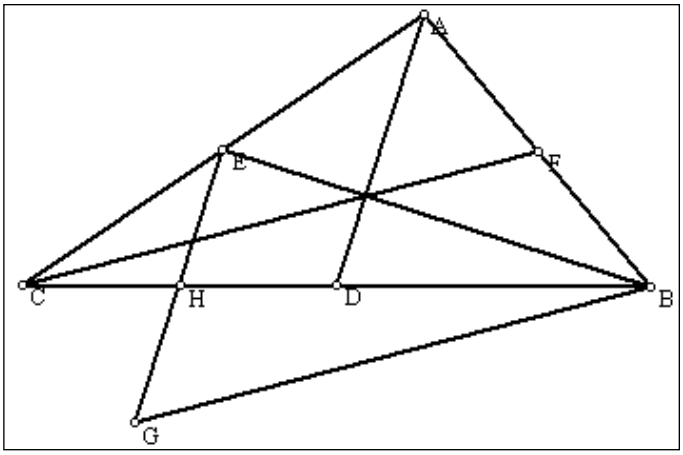


Figure 2. Construction of median triangle offspring by translating AD and CF

4. Construct the intersection point H of EG and BC.
5. Measure EH, HG, CH, and HD to confirm that EG and CD bisect each other.
6. Measure the areas of ΔABC and ΔEGB and calculate their ratios.
7. Click and drag on any point of ΔABC and observe the changes in areas and the area ratio.

Calculating the Ratio of Areas

The following are some questions you can ask to help students understand the area relationship:

1. What fraction of BC is HB?
2. How do the heights of ΔEHB and ΔECB compare?
3. Based on your answer to questions 1 and 2, what fraction of the area ΔECB is ΔEHB?
4. Explain why area ΔECB is $\frac{1}{2}$ area ΔABC, and area ΔEHB is $\frac{1}{2}$ area ΔEGB.
5. Now explain why the ratio of the areas of ΔEHB / ΔABC that you observed in *Sketchpad* is correct.

Although by answering the preceding questions, grade 9 students would be able to have some understanding why the area of the median offspring triangle is always $\frac{3}{4}$ of the area of the original triangle,

there is still the question of why the median offspring triangle exists in the first place. The construction of **figure 2** depends on the assumption that the translated medians meet at their endpoints G and that EG and CD bisect each other at H. Proving that median offspring triangles exist using traditional Euclidean geometry is quite difficult, but much easier using coordinate geometry. This motivates the following method, which could be done in the grade 12 Geometry and Discrete Mathematics course, or perhaps with high achieving students in grade 10 academic mathematics.

A Coordinate Geometry Method

A suitable choice of coordinate axes often make the solution of a problem simpler, which in this case, place ΔABC so that median BE is along the x-axis and E is at the origin O as in **figure 3**.

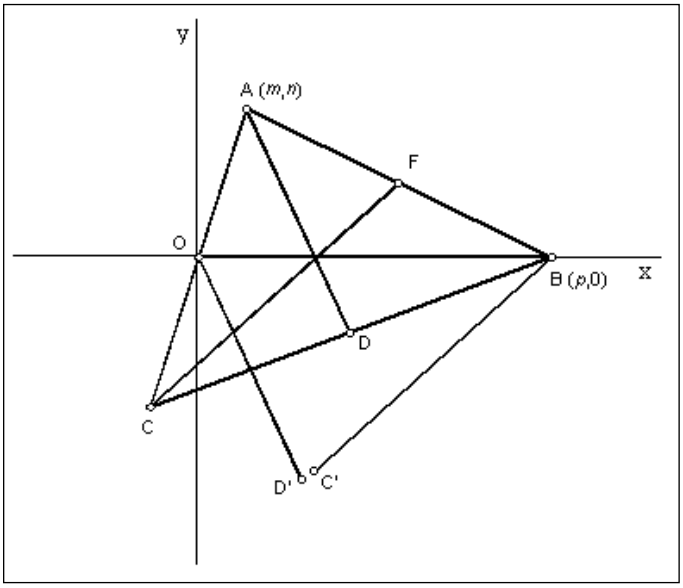


Figure 3. ΔABC in x-y plane with translations of AD to OD' and FC to BC'

1. Assuming that the coordinates of points A and B are (m,n) and (p,0) respectively, find expressions for the coordinates of points C, F, and D.
2. In **figure 3**, imitating the *Sketchpad* construction, median AD is translated so that A maps to O and D to D', and median CF is translated so that F maps to B and C to C' (point C' is deliberately made distinct from point D'). Find the coordinates of D' and C' so that OADD' and CFBC' are both parallelograms. Explain the significance of the answers.
3. In terms of m, n, and p, find expressions for the areas of triangles AOB, ABC, and OD'B. Explain what your answers mean.

A Revision of the Construction for Investigation 1

A construction procedure similar to that suggested in the *Sketchmad* web site can still be used. A simple change to building the median offspring triangle on one of the existing medians suffices.

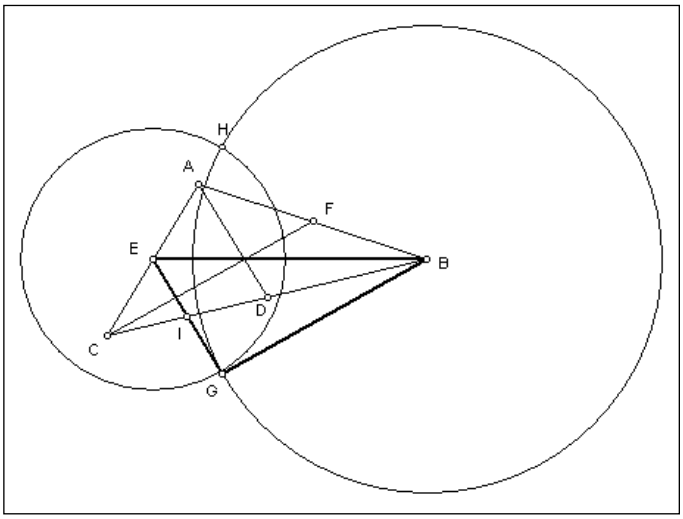


Figure 4. Construction of median triangle offspring on median BE

1. Construct ΔABC and its medians AD, BE, and CF.
2. Construct circles centred at the endpoints of one of the medians, whose radii are the lengths of the other two medians. Colour the circles with a different colour than the triangle.
3. Construct the intersection points of the two circles.
4. Complete the median triangle by constructing the segments from one of the points of intersection to the centres of circles (endpoints of first median). Use a thick line of another colour for the median triangle.

This construction is worthwhile because the existence of median offspring triangles is shown by the solution of a system of equations of the intersecting circles and is suitable in the grade 11 Functions and Relations course.

Systems of Equations Method

Placing ΔABC of **figure 4** in a coordinate system so that median EB is on the x-axis with E at the origin O, we get **figure 5**.

1. Assuming that the coordinates of points A and B are (m,n) and (p,0) respectively, find expressions for the coordinates of points C, F, and D.
2. Find the equations of the circles, centred at O and B with radii equal to the lengths of the medians AD and CF respectively.

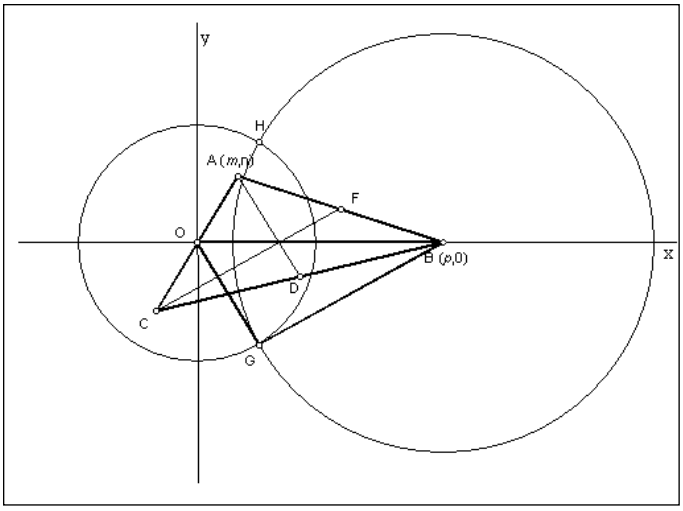


Figure 5. ΔABC and median triangle offspring in x-y coordinate plane

3. Solve the systems of equations to find the intersection point G. How does this show that the median triangle can always be constructed?
4. Find the areas of ΔOBG and ΔABC. Find the ratio of the area of the median offspring to that of the original triangle.
5. Explain whether the suggested coordinates for A and B allow for the creation of all possible triangles.

Vector Method

Perhaps the quickest way to deal with the situation is to use vectors (grade 12 Geometry and Discrete Mathematics). Indeed, representing median vectors in terms of the vectors for the sides of the triangle is probably the easiest way to show why medians always form a triangle. Applying cross products of vectors readily demonstrates the area ratio. In addition, vector methods generalize more readily to proving the invariance of the ratios of areas when cevians other than medians are drawn in a triangle (see investigation 2).

The ratio of areas can also be proven using vectors and cross products.

In ΔABC, let **a** = **CA** and **b** = **CB**.

1. Express the median vectors **AD**, **BE**, and **CF** in terms of **a** and **b**.
2. Prove that the median vectors form a triangle.
3. Show using cross products, that ratio of areas of the median triangle to the original triangle is 3:4.

Traditional Deductive Geometry Method

From a deductive point of view, the main difficulty of the construction of figure 2 is whether the translated medians EG and BG always meet at G. To get around this difficulty (among a number of possible choices) we make the following assumptions. In **figure 2**, AD, BE, and CF are medians of triangle ABC. Construct lines through E and B intersecting at G so that EG || AD and BG || CF.

1. Why must one prove EG = AD and GB = CF? (This question is intended to get students to think about the situation. Without these equalities, ΔEGB is not the median triangle.)
2. Draw a line through F parallel to AD intersecting CB at J.
3. Prove CH = DH, DJ = BJ, and CJ = HB.
4. Prove ΔFCJ ≅ ΔGBH, CF = BG, and FJ = GH.
5. Prove EH = FJ (= $\frac{1}{2}$ AD) and EG = AD.
6. Explain why ΔEGB is the median triangle offspring of ΔABC.
7. Find and prove the following ratios of areas of triangles:

   area ΔEHB : area ΔECB;

   area ΔEHB : area ΔEGB;

   area ΔECB : area ΔABC.
8. Now explain why area the area of the median triangle is $\frac{3}{4}$ of the area of the original triangle.

On Investigation 2

Investigation 2 asks students to think of other possible triangles that can be created from an original triangle. The most likely possibilities that grade 9 students would use are altitudes or angle bisectors to make offspring triangles. Unfortunately, concurrent cevians like altitudes or angle bisectors do not always result in offspring triangles, let alone constant area ratios.

Another possibility is to use cevians that cut the opposite sides in exactly the same ratio, such as points of trisection or points that divide sides of triangles into four equal segments. (Whether grade 9 students whose mindset may be only on medians, altitudes, and angle bisectors of triangle, come up with such cevians is uncertain.) Constructing a point on a line segment whose distance from an endpoint is $\frac{1}{3}$ or $\frac{1}{4}$ of the length of the segment can be done in *Sketchpad* as follows. Choose one endpoint as the marked centre by double clicking on it. Next select both endpoints and choose Dilate in the Transform menu. Enter the appropriate

scaling factors in the dilation window when it appears. **Figure 6** shows the construction of ΔABC and points G, H, and I so that AG : AB = BH : BC = CI : CA = 1 : 4. The offspring triangle was constructed by translating line segment AH to GH and IB to CJ. Employing *Geometer's Sketchpad* to do the area and ratio calculation, one is tempted to think that the area ratio is $\frac{81}{100}$. In actual fact, the ratio is $\frac{13}{16}$, which *Sketchpad* rounds to 0.81. As in Investigation 1, construction of the offspring on segment CG is more useful to assist in explaining why the ratio of areas is $\frac{13}{16}$. Now the mathematical challenge is to provide reasons for this ratio of areas.

The relationship between the area of a triangle and its offspring is most easily proven by generalizing the vector methods developed in investigating the median triangle offspring.

Draw ΔABC and place points G, H, and I along AB, BC, and CA respectively so that the ratios AG : GB = BH : HC = CI : IA = p : 1 – p. As before, let **a** = **CA** and **b** = **CB**.

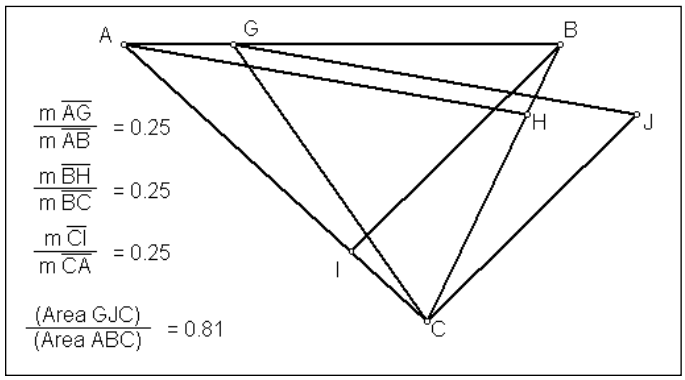


Figure 6. ΔABC and cevian offspring triangle GJC

1. Express the cevians vectors **AH**, **BI**, and **CG** in terms of **a** and **b** and prove that they form a triangle when rearranged.
2. Find the ratios of areas of the triangle formed by the cevians and the original triangle.

Conclusions

These possible solutions show that *Investigations 1 and 2* can become a mathematically rich learning task, but the way it has been presented in *A Handbook of Rich Learning Tasks* and on the *Sketchmad* web site, it is not a rich learning task. Unfortunately, most of the methods are beyond the grade 9 curriculum and belong more appropriately in the grade 12 Geometry and Discrete Mathematics course. It is in this course that students acquire the mathematical tools to make an investigation into median triangle offspring the rich mathematical learning experience it deserves to be.

If the *Geometer's Sketchpad* is to be used in geometric investigations, it should be used to enhance mathematical understanding and analysis. Also, the main focus of assessment of these tasks should be on the mathematical understanding that a student demonstrates. Skill in using *The Geometer's Sketchpad* should form only a minor part of the assessment. It is also important to align "rich learning" tasks with a set of significant mathematical skills and tools for students to use in their investigations. Care must be taken with how *Sketchpad* is used in the mathematics classroom so that it does provide new mathematical insights for the student, since after a student leaves high school, few will ever use *Geometer's Sketchpad* again.

Appendix: Some Solutions to the Above Questions

Investigation 1 Solutions

Coordinate Geometry Solution

1. If A(m,n) and B(p,0) then C(-m,-n), F($\frac{1}{2}$(m + p), $\frac{1}{2}$n), and D ($\frac{1}{2}$(p – m), -$\frac{1}{2}$ n).

2. Translating AD to OD' and FC to BC' we have the coordinates of D': ($\frac{1}{2}$(p – m) – m , – $\frac{1}{2}$n – n) = ($\frac{1}{2}$(p – 3m), -$\frac{3n}{2}$), and of C': (-m + p – $\frac{1}{2}$(m + p), -n – $\frac{n}{2}$) = ($\frac{1}{2}$ (p – 3m), -$\frac{3n}{2}$). Since D' and C' is the same point the three medians will meet to form a triangle.

3. Area AOB = $\frac{1}{2}$ np, so that Area ABC = np.
   Area OD'B = $\frac{1}{2}$ ($\frac{3n}{2}$)p = $\frac{3}{4}$ np.

Systems of Equations Solution

1. If A(m,n) and B(p,0), then C(-m,-n), F($\frac{1}{2}$(m + p), $\frac{1}{2}$ n), and D ($\frac{1}{2}$ (p – m), -$\frac{1}{2}$ n).

$$|AD|^2 = \left(\frac{p-m}{2} - m\right)^2 + \left(-\frac{n}{2} - n\right)^2 = \left(\frac{p-3m}{2}\right)^2 + \left(\frac{3n}{2}\right)^2, \text{ and}$$

$$|CF|^2 = \left(\frac{p+m}{2} + m\right)^2 + \left(\frac{n}{2} + n\right)^2 = \left(\frac{p+3p}{2}\right)^2 + \left(\frac{3n}{2}\right)^2.$$

Circle centre O and radius |AD| is

$$x^2 + y^2 = \left(\frac{p-3m}{2}\right)^2 + \left(\frac{3n}{2}\right)^2,$$

And the circle centre B radius |CF| is

$$(x-p)^2 + y^2 = \left(\frac{p+3m}{2}\right)^2 + \left(\frac{3n}{2}\right)^2.$$

2. Subtracting the equation of the first circle from the second:

$$(x-p)^2 - x^2 = \left(\frac{p+3m}{2}\right)^2 - \left(\frac{p-3m}{2}\right)^2.$$

Expanding and solving for x:

$$p^2 - 2px = 3mp$$

$$x = \frac{p-3m}{2}, \text{ since } p \neq 0.$$

Substituting into the first equation, we find: $y = \pm\frac{3n}{2}$. So that the intersection point G is $\left(\frac{p-3m}{2}, -\frac{3n}{2}\right)$. Since the system of equations can be solved, point G and the median triangle EGB always exists.

3. ΔOBG has base p and height $\frac{3n}{2}$, so its area is $\frac{3np}{4}$. Triangles AOB and COB both have bases p and heights n so their areas are $\frac{np}{2}$, which makes the area of ΔABC = np. Thus, the ratio of the areas of the median triangle OBG to the original triangle ΔABC is 3 : 4.

Vector Solution

In ΔABC, let vectors **a** = **CA** and **b** = **CB**.

1. **AD** = $\frac{1}{2}$**b** - **a**, **BE** = $\frac{1}{2}$**a** – **b** and **CF** = $\frac{1}{2}$**a** + $\frac{1}{2}$**b**.

2. **AD** + **BE** + **CF** =($\frac{1}{2}$**b** – **a**) + ($\frac{1}{2}$**a** – **b**) + ($\frac{1}{2}$**a** + $\frac{1}{2}$**b**)
= **0**.

3. **AD** x **BE** = ($\frac{1}{2}$**b** – **a**) x ($\frac{1}{2}$**a** – **b**)
= $\frac{1}{4}$**b** x **a** + **a** x **b** (expanding brackets and **a** x **a** = **b** x **b** = **0**)
= - $\frac{1}{4}$**a** x **b** + **a** x **b**
= $\frac{3}{4}$(**a** x **b**).

Traditional Deductive Geometry Solution

1. Each side of ΔEGB must equal one of the medians of ΔABC. We only have the shared median EB but we do not know that EG = AD nor BG = CF.

3. Since EG || AD and E is the midpoint of AC in ΔACD, by the triangle side split theorem, CH = HD. Similarly, DJ = JB. CJ = HB as both are $\frac{3}{4}$ BC.

4. EG || AD || FJ imply <FJH = <GHB. FC || BG implies <FCJ = <GBH. From #3, CJ = BH. ΔFCJ $\cong$ ΔGBH by ASA thus CF = BG and FJ = GH.

5. ΔECH ~ ΔACD by AA~ since EH || AD. EC = $\frac{1}{2}$ CA therefore EH = $\frac{1}{2}$ AD. Similarly FJ = $\frac{1}{2}$ AD, so that FJ = EH. EG = EH + HG = 2FJ = AD.

6. Each side of ΔEGB is equal to one of the medians of ΔABC.

7. The ratios are of course $\frac{3}{4}$, $\frac{1}{2}$, and $\frac{1}{2}$.

Investigation 2 Proof:

1. **AH** = (1 – p)**b** – **a**, **BI** = p**a** – **b** and **CG** = (1 – p)**a** + p**b**. Then **AH** + **BI** + **CG** = [(1 – p)**b** – p**a**] + [p**a** – **b**] + [(1 – p)**a** + p**b**] = **0**, so that the cevians do indeed form a triangle and it is possible to construct ΔGCJ with BI = JC and AH = GJ.

2. **GJ** x **GC** = -**AH** x **CG** = -[(1 – p)**b** – **a**] x [(1 – p)**a** + p**b**] = -[(1 – p)^2 **b** x **a** – p**a** x **b**] = (1 – p)^2 **a** x **b** + p**a** x **b** = (p^2 – p + 1) **a** x **b**.
Thus the ratio of areas of the triangles is (p^2 – p + 1) : 1. In the *Sketchpad* diagram in **Figure 6**, with p = $\frac{1}{4}$, the ratio is 13 : 16.

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PEARSON

▲ Graphing Inequalities - A Fruitful Connection

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NANYANG TECHNOLOGICAL UNIVERSITY
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Eric Wood began teaching secondary school mathematics in 1969. After more than 30 years as a teacher and teacher educator in Ontario, he decided it was time for a change. He presently teaches mathematics methods courses to preservice teachers at the National Institute of Education in Singapore. (Eric is pictured with a group of students – can you guess who he is?)

The theme of connections is featured prominently in much of the recent reform literature. Although connections are often taken to mean connections between mathematics and other subjects, it is also possible to think of teaching mathematics itself in a generally connected fashion. This article describes a method of teaching a standard topic in a non-standard way that I have used with success. It also illustrates how topics that seem to be new and different can often be connected to students' prior knowledge.

When faced with the problem of graphing an inequality such as $y > 2x + 3$, a standard approach would consist of three steps:

- Graph the boundary by graphing the corresponding equality;
- Test a point not on the boundary to see if it satisfies the original inequality or not;
- Shade the appropriate region.

There is nothing intrinsically wrong with this kind of approach; in fact, it is precisely the way that I want my students to do the problem **ultimately** because this method can then be applied in any situation where the plane is divided into two discrete regions by the boundary, whether it is a straight line or a curve. At the outset, however, I want them to be able to **develop** the idea that the graph turns out to be an entire region rather than the single line graphs that they are used to as well as **understand** how the boundary would be established. A typical worksheet that allows this material to be done with a minimum of teacher direction is included in the Appendix. One copy is left blank so that it can be used as a blackline master; the second has typical student responses provided.

Using the Worksheet

A convenient way to use this worksheet in the classroom is to make a transparency and use it to fill in appropriate information after students have had the opportunity to grapple with the ideas independently. This also provides a good record of the lesson for students whose note taking and organizational skills are weak. The main pedagogical purpose of this worksheet is to allow students to see the graphing of an inequation as being linked to the graphing of a straight line. The worksheet also allows them to actively develop that idea on their own. It is for this reason that I would start with an inequation in the form $x + y < 6$ rather than the more

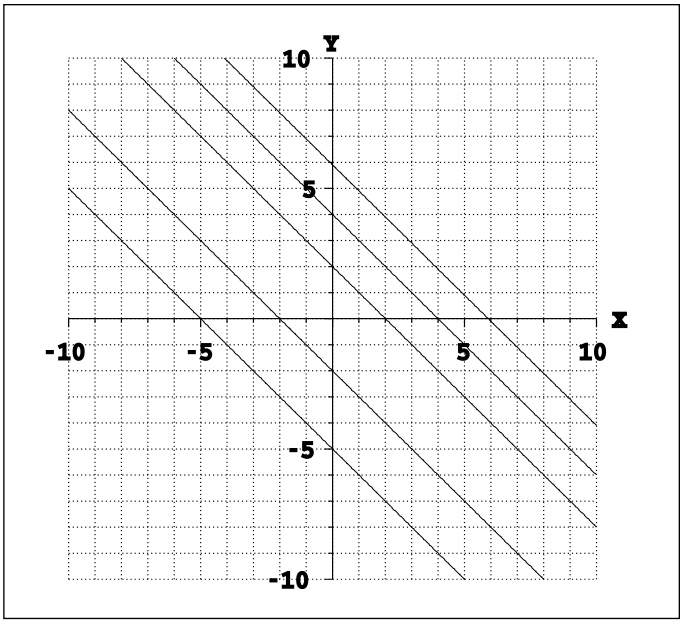


Figure 1.

typical $y < -x + 6$. Students can then more easily see that the statement $x + y = 5$ satisfies the condition that $x + y < 6$, while $x + y = 7$ does not. They can readily list a variety of equations that satisfy the required condition and then graph the series of linear equations that they themselves have established to see if the result of graphing $x + y < 6$ is more obvious. A typical student graph is shown in Figure 1.

Pupils can easily see that the line $x + y = 6$ is the first one where the constant term is too large and they can be questioned to decide on a good method of indicating this fact. Typically, it is the class who suggest using a dotted line. In addition, the idea that the entire plane below this boundary is included is obvious from the fact that we have infinitely many parallel lines making up the set of appropriate conditions. Eventually, they will produce the graph shown in Figure 2.

Once students appreciate that inequalities are just a short form for a large number of equations, it makes sense that the graph of a linear inequality will consist of many lines. The idea of shading in the plane then becomes self-evident. At this stage, the teacher can help the class to summarize the important features of the graph of an inequality and move to the more conventional method of graphing. Clearly, the graphing

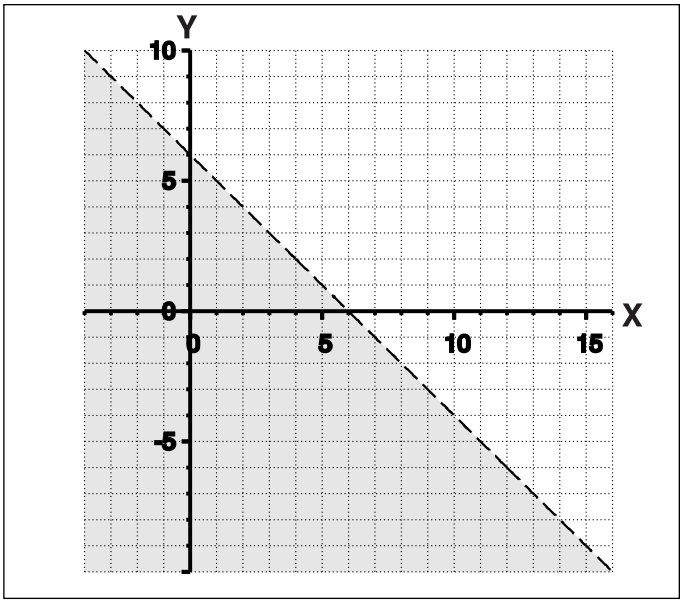


Figure 2.

of the lines is not the most important idea in this lesson; rather it is the notion that a region can be formed by infinitely many lines. Using technology such as a graphing calculator or graphing software and then having the students copy the results onto the blank grids in the lesson would also be an appropriate way to generate this idea.

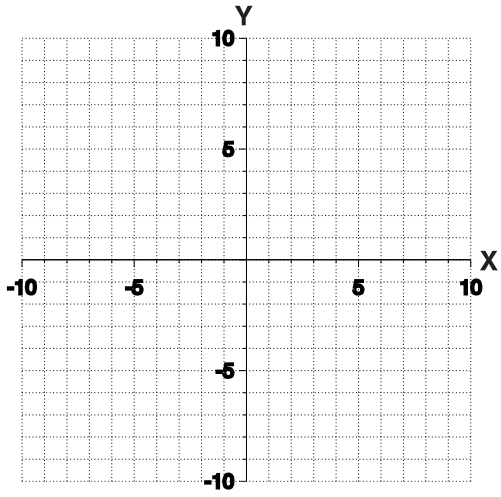
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Although the final method of graphing linear inequalities remains the traditional one, the path that the students take when using this approach does make use of previous knowledge and shows them that mathematical ideas are fundamentally connected. It also allows students to be actively involved in the construction of their own understanding of the topic.

Appendix

The equation y = 3x + 2 is called a *(linear)* equation and when it is graphed, it will result in a *(straight)* *(line)*. The expression x + y < 6 is not an equation because it contains an *(inequality)* sign rather than an *(equals)* sign. Consequently, it is not clear what the graph would look like. Let's look at the problem of drawing the graph of x + y < 6 and see if we can relate it to things we already know. If we want x + y to be less than 6, we might choose x + y to be *(3)*, for example. So x + y = *(3)* satisfies the condition that x + y < 6. Another equation that satisfies the condition that x + y < 6 could be x + y = *(5)*. One that does not satisfy the required condition would be x + y = *(7)*. List below 8 equations that satisfy the condition that x + y < 6 and then graph each line on the axes provided:

1. x + y =
2. x + y =
3.
4.
5.
6.
7.
8.

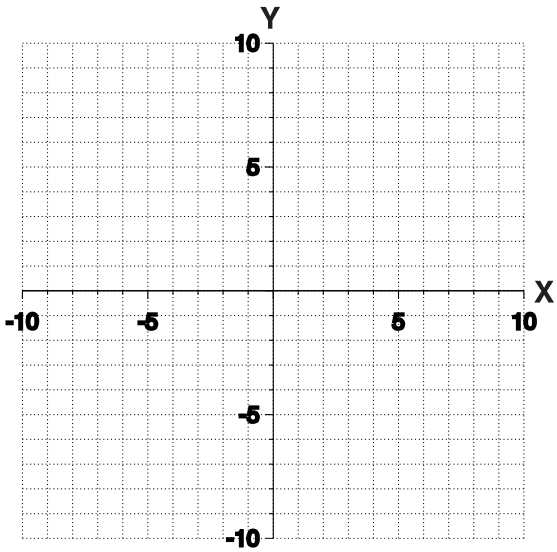


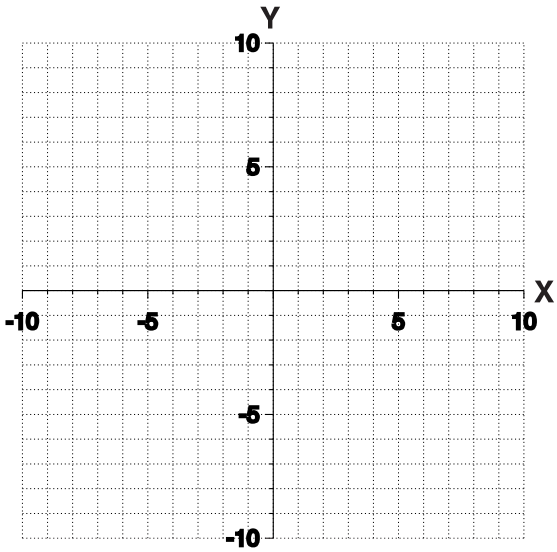
What do you notice about all the lines that you have drawn so far? *(They are all parallel)*. Is there any limit to the number of lines that you could draw if you had the time? *(No)*. Why doesn't the equation x + y = 6 work? *(Because 6 is not less than 6)*. How about x + y = 5.9? *(Yes)*. Why? *(5.9 is less than 6)*. How could you show that all lines up to but not including x + y = 6 are acceptable? *(Shade region below and draw x + y = 6 as a dotted line)*.

Perhaps we need not do all this work every time. How can we find the boundary for our inequality? *(Just change the sign to equals and graph it!)*.

How many regions does this boundary divide the plane into? *(Two)*. What must be true of all points in the correct region? *(They will satisfy the original inequality)*. Pick one point in the correct region and substitute it into the inequality x + y < 6. What do you find? *(It works)*. Pick one point in the incorrect region and substitute it into the inequality x + y < 6. What do you find? *(It doesn't work)*. So once we have the boundary established all we really need to do is *(Pick one point and check it)*.

Use this shorter method to draw the graphs of y < 3x + 2 and y ≥ 2x – 1.

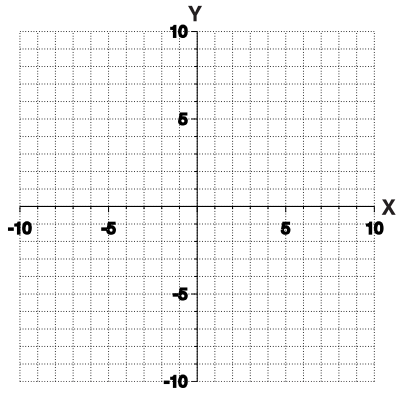




Graphing Linear Inequalities

The equation y = 3x + 2 is called a _____ equation and when it is graphed, it will result in a _____ _____ . The expression x + y < 6 is not an equation because it contains an _____ sign rather than an _____ sign. Consequently, it is not clear what the graph would look like. Let's look at the problem of drawing the graph of x + y < 6 and see if we can relate it to things we already know. If we want x + y to be less than 6, we might choose x + y to be ____ , for example. So x + y = _____ satisfies the condition that x + y < 6. Another equation that satisfies the condition that x + y < 6 could be x + y = ____. One that does not satisfy the required condition would be x + y = ____. List below 8 equations that satisfy the condition that x + y < 6 and then graph each line on the axes provided:

1. x + y =
2. x + y =
3.
4.
5.
6.
7.
8.

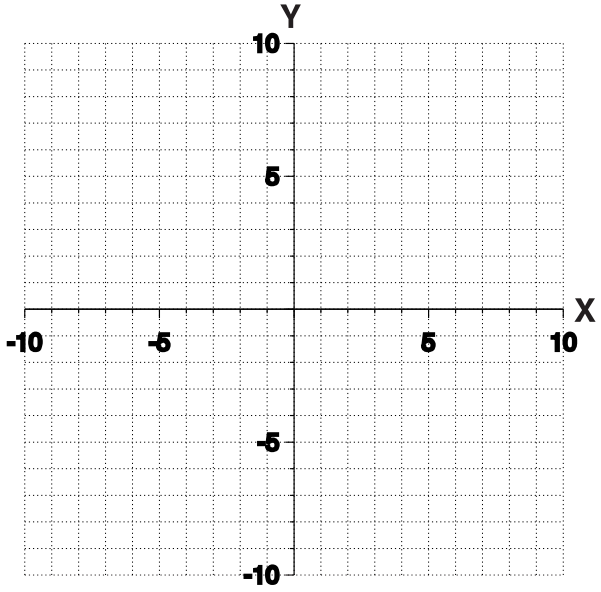


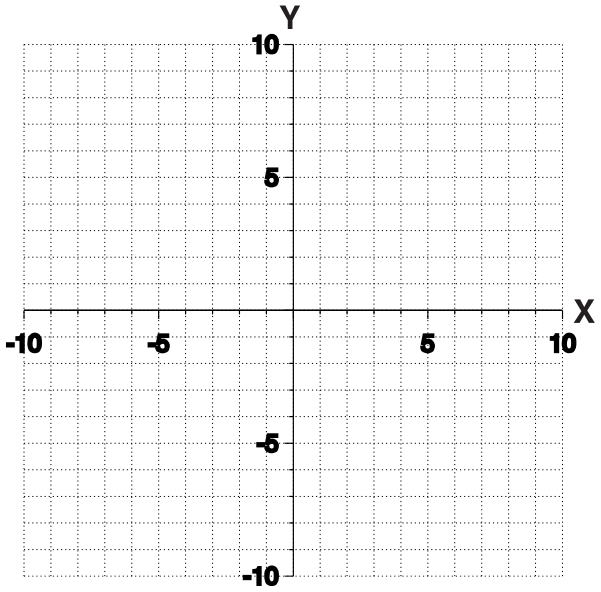
What do you notice about all the lines that you have drawn so far? _____. Is there any limit to the number of lines that you could draw if you had the time? _____. Why doesn't the equation x + y = 6 work? _____. How about x + y = 5.9? ____. Why? _____. How could you show that all lines up to but not including x + y = 6 are acceptable?_____.

_____. Perhaps we need not do all this work every time. How can we find the boundary for our inequality?_____.

How many regions does this boundary divide the plane into? _____. What must be true of all points in the correct region? _____. Pick one point in the correct region and substitute it into the inequality x + y < 6. What do you find? _____. Pick one point in the incorrect region and substitute it into the inequality x + y < 6. What do you find? _____. So once we have the boundary established all we really need to do is _____.

Use this shorter method to draw the graphs of y < 3x + 2 and y ≥ 2x - 1.





▲ Union Gas Awards

DAVE AND SUE HESSEY
EXECUTIVE DIRECTORS, OAME
AND STEWART CRAVEN, PRESIDENT OF OAME



In early January, directors of each of the seventy-two school boards in Ontario were invited by the Ontario Association for Mathematics Education to nominate three employees who have made an outstanding contribution to student learning of mathematics. All three award winners were publicly recognized at the annual OAME conference held at Durham College in Oshawa on May 10th. The awards were presented by David Rosenbloom, Manager, Community Relations, Union Gas. Together with their parent corporation Duke Energy, Union Gas has a mandate to focus on building leadership capacity in not for profit organizations, encouraging employee volunteerism, and supporting Mathematics and Science Education. Union Gas sponsored these new awards and continues to provide financial support to OAME because of their belief in a strong foundation in Mathematics for Ontario's workforce.

OAME recognizes the critical role that teachers play in creating an atmosphere for learning mathematics. They do this by preparing motivating lessons that often employ manipulatives or technology, by encouraging students to talk with each other to construct their understanding, and by using rich and varied assessments to inform their teaching and improve students' learning. These teachers invariably go the extra "kilometre" to help students individually, to participate in extra-curricular activities, and to communicate with parents. The first two new Union Gas awards are specifically for an elementary and a secondary teacher. The third new Union Gas award recognizes a lead teacher, a department head, a resource teacher or teacher-consultant, or an administrator who has a strong commitment to a progressive vision for mathematics education and has played an influential role in motivating mathematics teachers and to facilitating their professional growth.

Board	Elementary Nominee	Secondary Nominee	Leadership Nominee
Bluewater DSB		Henry Mengers	
CDSB of Eastern Ontario		Jim Hunter	
CSD Centre Sud-Ouest			Noel Lauzon
Dufferin Peel CDSB		Claudio Att	
Durham CDSB		Lori Ann Malachowski	Dave Lamontagne
Grand Erie DSB	Rod Bowers		
Halton DSB	Roz Thomson		Ruth Dawson
Huron-Superior CDSB		Larry Marsh	
Kawartha Pine Ridge DSB		David Bowers	Ronald Fischl
Keewatin-Patricia DSB		Randy Moran	
London DCSB			Mary Howe
Ottawa-Carleton DSB	Sandra Duff	Susan Guzzo	
Peel DSB	Jan Crofoot	Fred Ferneyhough	Lindy Smith
Renfrew County DSB	Blanche Thomas		
St. Clair CDSB	Paul John Pearson		
Sudbury CDSB		Mina Thornton	
Toronto DSB	Phyllis Mok	Steffi Nathan	Sandy DiLena
Windsor-Essex CDSB			Frank Di Pietro
York CDSB			Connie Quadrini
York Region DSB	Wendy Howes		

Special congratulations to the 2003 **"Ontario Mathematics Educators of the Year"**:

1. The Union Gas Award for Teaching Excellence in Mathematics (elementary), awarded to **Blanche Thomas** of Renfrew County DSB
2. The Union Gas Award for Teaching Excellence in Mathematics (secondary) awarded to **Susan Guzzo** of Ottawa Carleton DSB
3. The Union Gas Award for Outstanding Leadership in Mathematics Education awarded to **Connie Quadrini** of York Catholic DSB.

Congratulations also to the Ontario educators who were nominated by their boards. They are all deserving of recognition as outstanding mathematics teachers and/or leaders. ▲

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

▲ Book Review: *Children Are Mathematical Problem Solvers*

REVIEWED BY: PAT MARGERM

Pat Margerm taught all elementary grades with both the Toronto District and Toronto Catholic District School Boards. She is now working independently and is involved in several projects including teaching MST courses in the preservice program of the Faculty of Education at York University and an Additional Basic Qualifications course in Intermediate Mathematics.

Children Are Mathematical Problem Solvers by Lynae E. Sakshaug, Melfried Olson, and Judith Olson is a collection of problems that were originally published in the "Problem Solvers" column in *Teaching Children Mathematics*, the National Council of Teachers of Mathematics (NCTM)'s journal for elementary teachers over a period of three years, from 1997 to 2000.

The book begins with a brief overview of key ideas about problems and problem solving, organized with the following headings:

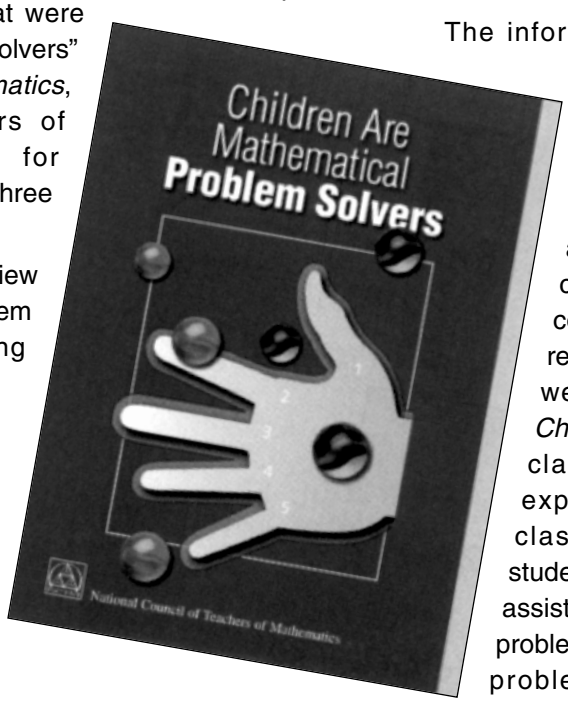
- What is Problem Solving?
- What is a problem?
- What is a Good Problem?
- What Does it Mean to Be Successful at Problem Solving?
- The Teacher's Role in Problem Solving
- Learning Mathematics through Problem Solving

This section also includes a table that identifies recommended NCTM grade levels and content and process standards for each problem. All of the problems are classified as addressing standards in more than one strand. Almost all of them are cross-classified as being in both the Number and Patterns/Algebra strands, about two-thirds also are classified as being problems for Data & Probability, and only about six or seven problems are identified for the Geometry and Measurement strands.

The remainder of the book presents 29 problems that were originally published in the "Problem Solvers" column. Each problem is organized using the following headings:

- The Problem
- Range of Possible Teacher Questions
- Where's the Math?
- Samples of How the Problem was Solved
- What are the Students Telling Us?

The analysis of the mathematics under the heading, "Where's the Math?" is a general summary of the math skills and concepts that can be developed through the problem as well as a description of opportunities to develop process standards such as communicating and representing. Readers of the *Gazette* would need to extend this analysis of the problems in order to identify specific concepts and skills from the Ontario curriculum expectations.



The information provided under the heading, "Samples of How the Problem Was Solved", is particularly helpful for teachers looking for useful ideas for successfully adapting the problems in classrooms. This section contains a sampling of student responses to the problems that were sent in to the *Teaching Children Mathematics* journal by classroom teachers. The experiences of a variety of classroom teachers and their students with solving each problem assist the reader to understand the problem, the math used to solve the problem, the possible problem solving strategies, and the solutions. The challenges that students experienced in understanding the problem, in developing and carrying out a plan, and the methods used to communicate their thinking are shared. Strategies that teachers used to introduce the problem, to respond to student difficulties,

and to assess student learning are also shared.

The specific examples of student responses from a range of grades allow teachers to understand how students with different levels of skills and understanding might respond to the problem. The classroom examples also give teachers direction for how the problems can be modified for students who are learning expectations that are below grade level.

Problem solving continues to receive much attention. A large portion of the "Notes to Teachers" section at the back of the Ontario elementary mathematics curriculum is devoted to information about problem solving. It is described as an integral part of all mathematics learning in NCTM's *Principles and Standards for School Mathematics*. The role of problem solving is a focus in the TIMSS video study that compares approaches to teaching mathematics in different countries. This book provides a useful collection of problems that can be used to develop mathematics lessons that are centred on problem solving.

Try this problem with your students:

What Shapes Can You Make?
Use four isosceles triangles and place all of them together along edges with no overlapping. How many different figures can be made?

To see samples of classroom experiences that accompany this problem from prekindergarten, primary, junior, and intermediate classrooms, you'll need to purchase the resource. *Children Are Mathematical Problem Solvers*, published by the NCTM (stock #12340C4), can be purchased through OAME's NCTM-representative, Frances Schatz at frances.schatz@sympatico.ca. ▲

▲ 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.

NOMINATION FORM

I nominate: _____

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

Nominee's Address: _____

_____

Telephone: H ( ) _____ W ( )_____

Nominator's Name : _____

Nominator's Address: _____

Telephone: H ( ) _____ W ( )_____

▲ Photo Math – A New Way of Picturing Math

RON LANCASTER



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 purpose of this column is to go beyond this notion and promote the idea that in fact, "A picture is worth a thousand numbers." Readers can expect to find photos with mathematics 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 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 columnist 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 June 2003 Column

The following photographs were taken in Charlotte, North Carolina during a trip I took in October 2002. When working on Questions 1 and 2, students should not have access to these introductory comments, otherwise the answer (Charlotte) will be obvious.

The photographs in Questions 1 and 2 were taken in a beautiful park that was completely designed with a literary theme. Everywhere you look, there are references to books and writers.

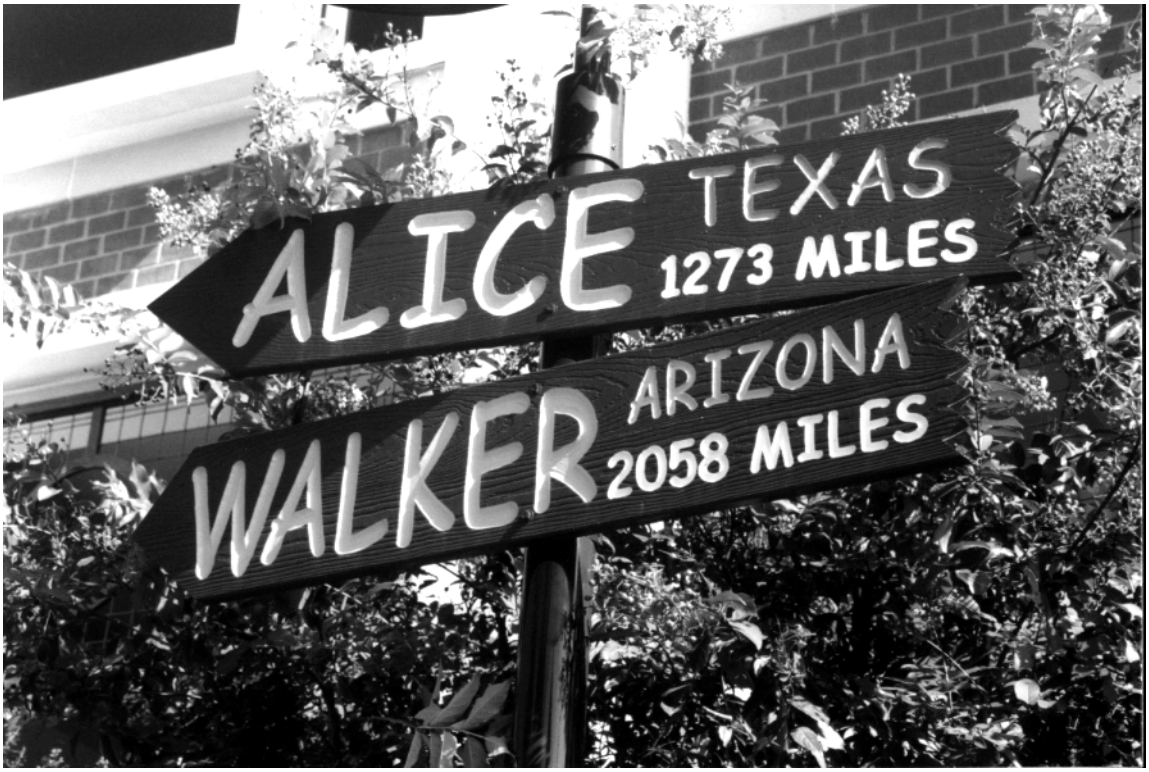
The photograph in Question 3 shows one of over 400 panels that have been installed on the outside wall of a parking garage in downtown Charlotte. These panels go all the way around the huge garage and are all different. The effect is quite pleasing to the eye. About a year prior to this trip, I had been in Charlotte to work at a school, and late at night after dinner, the Head of the Mathematics Department took me downtown to see this building. We walked around the garage and she directed my attention to fins located at street level directly below the large panels. These fins were designed so when a person touched them, sounds and lights would go off. If fins were touched in a certain pattern, the entire building would respond by playing a short piece of jazz with sound and light. We tried unsuccessfully to solve the puzzle of which pattern should be used. The artist who created this artistic/musical/mathematical work is Chris Janney. He has done a number of outstanding and very engaging projects with light and sound. More information about his work can be found at the following web sites:

Touch My Building http://www.janney.com/touch.html
Welcome to PhenomenArts http://www.janney.com/
Steamboat Monument Worth a Whistle http://enquirer.com/editions/2002/11/19/tem_tuelede19.html

"When students can connect mathematical ideas, their understanding is deeper and more lasting. They can see mathematical connections in the rich interplay among mathematical topics, in contexts that relate mathematics to other subjects, and in their own interests and experience. Through instruction that emphasizes the interrelatedness of mathematical ideas, students not only learn mathematics, they also learn about the utility of mathematics."

(NCTM's Principles and Standards for School Mathematics, 2000, p. 66)

Photograph #1



This photograph was taken in the downtown area of a city in the United States.

(a) Consult a map of the United States, and without making any measurements, try to locate the general area of the country (northeast, northwest, southeast, southwest) where this photograph was taken.

(b) Use an atlas or web site that gives the distance between cities along with some mathematics to find the name of the city where the photograph was taken. What tools would you need to find the precise location?

(c) Design a similar sign that spells out the name of a person at your school. Be sure to use real cities and include the distances from the two cities to the city you live in.

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Photograph #2



(a) This sign shows the distances from the city where the photograph was taken to three different cities in North America. Does having three cities involved (as opposed to two) make it any easier to locate the city where the photograph was taken?

(b) In what province is Allan, Canada? How many people live in Allan? Is it a city or a town?

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Photograph #3



This photograph shows two of over 400 panels that have been installed on the outside wall of a parking garage in the same city where the photographs in Questions 1 and 2 were taken. These panels go all the way around the garage and are all different. The artist has created an amazing music/light show related to how people touch fins that are located beneath the panels. Your teacher has the name of the artist and several related web sites.

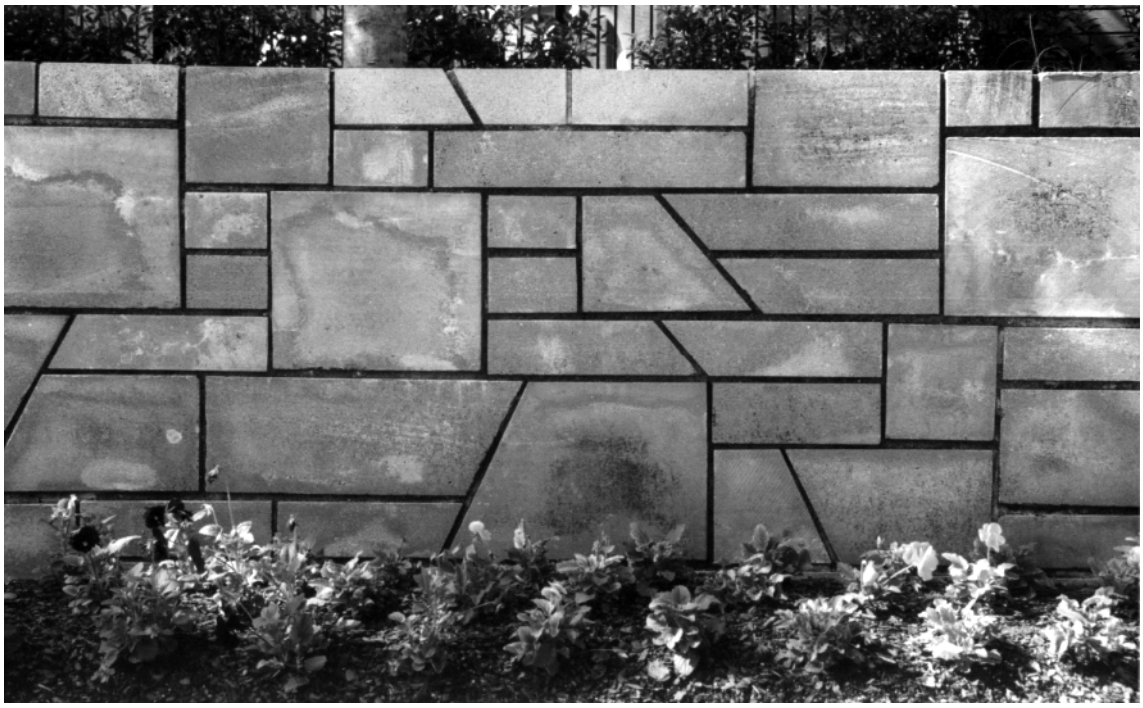
(a) Each panel contains eight rectangles, some oriented the same way, others rotated through an angle that is different from all others. How many different ways can a single rectangle be oriented?

(b) How many different ways are there of arranging the eight rectangles on one panel?

(c) Is there any connection between how the eight rectangles have been oriented in the left panel and how they have been arranged in the panel to the right?

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Photograph #4



This photograph shows a beautiful wall close to the garage discussed in Question 3. It would be hard not to admire the manner in which various shapes have been arranged.

(a) Let's have a scavenger hunt! How many different shapes can you find on the wall?

(b) Find two shapes that have the same area. Find two shapes for which the area of one is twice the area of the other.

(c) Create a sketch using the *Geometer's Sketchpad* that is identical (or close to being so) to the portion of the wall shown in the photograph. Use the area command to find the area of all the shapes and then answer the question in part (b).

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OAME 2004

▲ Directors' Dialogue



MARILYN HURRELL, NWOAME
THUNDER BAY, ON

This edition of Directors' Dialogue *highlights events at the Friday and Saturday, February 7 and 8, 2003 OAME Board of Directors' meeting at the Four Points Hotel in Mississauga.*

Visions Committee: The Visions Committee met at 5 p.m. to discuss the progress of the *Vision for Mathematics in Ontario: JK to 12* initiative. Subcommittees are hard at work preparing and testing teaching ideas and strategies for all divisions. This is a BIG project for OAME this year, and will feature a PD package as well as a video. The Visions Committee hopes to have everything in place for next September for testing, with marketing shortly after that.

The **Forum** began at 7 p.m. with all members of the Board. President Marg Warren welcomed Executive, Elected Directors, and Chapter Representatives. The task was to work in small groups to discuss the following: "Using our beliefs and principles of the learning of mathematics, clarify our vision of math education by referencing relevant and practical examples of teaching practices and learning approaches". Here are a few of the many ideas that emerged:

- All students learn by building on prior knowledge and understand at a developmentally appropriate level;
- Elementary: Use manipulatives so students can "experience" the concepts;
- Secondary: Use contexts and examples that students can relate to. Use graphing calculators/computers for many tasks;
- The learning process is enhanced when new ideas are presented in a variety of ways and all learners have access to "hands-on" and "minds-on" activities and opportunities to use mathematical objects and resources (e.g., use snowboarding examples in grade 9 classes);
- All students must be included (e.g., ESL, ESD, special education);
- Learners require opportunities to interact with each other, to teach others, and to explain and justify the processes of mathematics;
- Learning involves planned teaching, coaching, assisting, supporting, and providing feedback to the learner in order to improve learning.

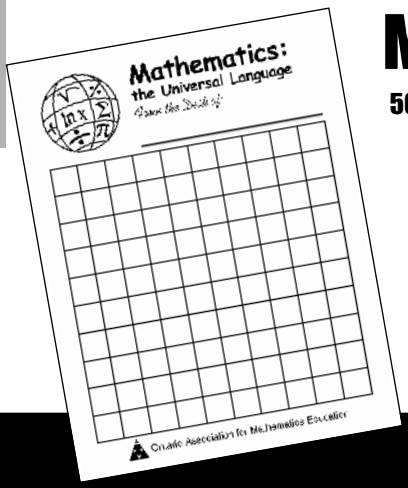
The **Chapter Reps Meeting** began at 8 p.m. Heather Boychuk of the Futures Committee asked all Chapters to consider hosting either an OAME Conference or Ontario Mathematics Olympics (OMO)

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during the next five years. Chapter rebates were handed out and Chapter lists distributed. A discussion followed, "What is a Chapter in good standing?" This would be a Chapter that has at least one event per year, has an expanding membership, uses its rebate to provide support for members, and has made the required annual Chapter Report to Executive, including a bank statement. Discussion followed about Chapters receiving rebates when no local activities are planned.

The **Standing Committees** also met on Friday evening. All OAME Directors are members of at least one Standing Committee. Here are some brief reports:

Futures: Heather Boychuk is looking for hosts for OAME'2006 and OMO'2004.

Promotions: Gord Cooke reported that the committee has decided to purchase and sell two promotional items: sticky-note graphs and T-shirts. These will be for sale at the OAME conference in May.

Publications: John Dallan is costing out a "Web Site Wish List" and he plans to have ready for the June meeting presentations by persons interested in developing it. Louis Lim will resign as editor of the *Gazette* in June. Marilyn Hurrell volunteered for this position and an editorial panel will be in place by June. Frances Schatz presented her *Abacus* report and asked for help with the needs of elementary teachers around the issues of homework and home connections.

Equity: Stewart Craven reported that all is set for the Equity breakfast at OAME'2003. Dr. Avis Glaze, director of education for the Kawartha Pine Ridge DSB, will be keynote speaker.

Awards: Stewart Craven announced that there are three Union Gas awards. Nominees for OAME Awards for 2003 are in place.

Recognition of non-returning members: Marg Warren thanked the following for their contributions as OAME Directors and Executive members over many years and wished them well: Susan Stuart, John Rodger, Lynn Strangway, and Shirley Dalrymple.

Vision Project: The Visions Committee presented the following Key Discussion Questions:

- What does effective professional development in mathematics look and sound like?
- How do we know when math PD is effective?
- What components should be in the OAME Vision PD package?

Discussion followed until 11 a.m.

An **NCTM** Presentation was made by David Decoste, our regional services NCTM representative. He talked about current NCTM projects, and presented Marg Warren with two $40 NCTM gift certificates to be used at the OAME Leadership conference. Irene McEvoy was selected as OAME's rep to the NCTM Annual Conference in San Antonio, Texas.

Project Committee Reports were presented:

JK-6: Laurie Moher reported that the committee has revised and piloted the JK task in February and March. The other tasks will be piloted in the spring.

7&8: Caroline Rosenbloom reported that two tasks have been revised and piloted, starting in April.

9&10: Irene McEvoy reported that the bungee task has been piloted and the popcorn task will be included in the video.

11C: Dan Charbonneau reported that his committee worked all day on February 7. Their task is to develop summative assessments over a four-day period involving three strands.

11U/C: Ron Gaudreau reported that two tasks will be field-tested in the spring and samples collected.

Written reports were distributed from the Executive Directors, NCTM, and OMCA (Ontario Mathematics Coordinators' Association). A report was also given from OTF (Ontario Teachers' Federation).

Chapter News

CHAMP: Rep Lindy Smith: lindy.smith@peelsb.com No report.

COMA: Rep Peter Lenczewski: petelenc@compmore.net COMA held a very successful conference in November 2002, in conjunction with the University of Ottawa. Another conference is planned for the fall of 2003. Forums will be held in April 2003 with Mary Lou Kestell speaking with Elementary teachers; a Secondary panel discussion will also be held. Two teams from the COMA chapter will be sent to the Ontario Math Olympics (OMO) this June.

GOLDEN: Rep Ed Haines: ed.haines@dsbn.edu.on.ca The Golden chapter will host their Annual Spring conference in April at Brock University. The workshops will feature many topics in grades 7 - 12.

GVMA: Rep Paul Fennell: pmfennell@odyssey.on.ca Check out GVMA's web site

at http://home. golden.net/~gvma. A conference will be held on April 10; the next will be on November 13 from 4 to 8:30 p.m. Contact Paul for details. Planning for OAME'2004 is underway with co-chairs Dean Murray and Paul Fennell. The provincial conference will be held at the University of Waterloo from April 28 to May 1. Residences have been booked.

ISOMA: Rep Brian Raaflaub: braaflaub@appleby.on.ca St. Clement's School and Branksome Hall will host ISOMA's 2003 Math Chapter Olympics. Now that the final stages of the new curriculum have been implemented, ISOMA members are encouraged to run for office on the ISOMA Executive to assist in the promotion and sharing of ideas among its members and the greater Math community. Please send Brian your e-mail. Elections will be held electronically. A Spring mini-conference will be hosted by Appleby College on April 3, 2003. The format will be round table sharing of "Best Practices".

MAC²: Rep Greg Clarke: gpclarke@smcdsb.on.ca The Fall conference became the Spring 2003 Conference and will be held on April 10. There are 6 speakers, including a *Geometer's Sketchpad* workshop for Elementary and *Fathom* for Secondary. An Olympic style Junior Math Challenge will be held March 26 by MAC². MAC² will sponsor 2 people to OAME'2003 and one member to the NCTM annual meeting in Texas. The MAC² web site has been updated, http://smcdsb.on.ca/secondary/MAC2/ .

NOMA: Rep Pauline Therrien: therrip@scdsb.edu.on.ca The fall conference in October 2002 was a success. NOMA is recruiting more French speaking teachers, and will contact all members who have not renewed. NOMA will send one member to the Leadership in February, and will host NOMA Chat Nights on February 12 and 18 for both Elementary and Secondary. They plan to send a team to the provincial Math Olympics in London.

NWOAME: Rep Rona Doyle: trdoyle1@yahoo.com NWOAME is in a rebuilding stage. A Dinnerlude is planned for late April, and a district wide conference will be scheduled for early fall.

PINE RIDGE: Rep Jacqueline Hill: jacqueline_hill@durham.edu.on.ca PRMA will hold a Prime Annual OAME Conference in May 2003. Teams will be sent to OMO in London.

QSLMA: Rep Robert Sherk: sherkr@limestone.on.ca Last November, a successful conference was held with over 90 people attending. The Executive promoted OAME 2003 through its e-mail network and hopes to hold a local OMO in the near future. The Chapter also plans to hold an all day local Leadership conference.

SAME: Rep Sumintra Koowar: Sumintra.Koowar@etel.tdsb.on.ca SAME will hold a conference in late April.

SWOAME: Rep David Petro: david_petro@wecdsb.on.ca SWOAME's goals this year are to increase membership, send teams to OMO, hold workshops on *Fathom*, *Sketchpad* 4.0, and Assessment and Evaluation guidelines. Contact David Petro for details.

TEAMS: Rep Pat Margerm: pmargerm@edu.yorku.ca TEAMS will hold their annual "Building Our Math Community" mini-conference on February 6, 2003. Keynote is Dr. Lynda Colgan, who will also present a workshop. Some workshop titles include Primary: "Strategies to Develop Early Number Strategies"; Junior: "Mathematics is...the Study of Patterns"; Intermediate: "78% of all Statistics are Made Up!"; Senior: "Going Deeper: Proof in MGA4U". A newsletter will be distributed in February featuring summaries and photographs from the mini-conference and information about OMO events. This year, a fee of $10 per person was charged to cover OMO events.

WOMA: Rep John Ferguson: fergus@xcelco.on.ca WOMA held a successful three part workshop series called "Dinner and a Manipulative" for elementary teachers in November 2002. A Spring Conference will be held on April 10. Math enrichment continues under the leadership of Tom Griffiths and Marg Kemp. A team of students will go to ARML at Penn State University. WOMA is preparing to hold the Union Gas/OAME OMO on June 13 and 14 at the University of Western Ontario. Check the WOMA web site for details, http://www.math.uwo.ca/woma/ .

Y⁴MA: Rep Rosey Mastrofrancesco: roseym5@rogers.com In October 2002, Y⁴MA hosted their annual fall conference at Earl Haig SS. It was well attended. They continue to update their web site, www.y4ma.com, with resources and monthly prize winners. A meeting will occur soon to discuss future events.

Meeting adjourned at 4:00 p.m.

Closing Remarks

By the time you read this, summer will be just around the corner. Have a safe and happy break.

Marilyn

▲ 2003-2004 OAME Board

Direct General Inquiries to:
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Stewart Craven

PAST PRESIDENT
Margaret Warren

PRESIDENT-ELECT
Gordon Cooke

VICE PRESIDENTS
Kathy Kubota-Zarivnij

Judy Dussiaume

Caroline Rosenbloom

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COMA - **TBA**
GOLDEN - **Ed Haines**

GVMA - **Paul Fennell**

ISOMA - **TBA**
MAC^2 - **Greg Clarke**

NOMA - **TBA**
NWOAME - **Rona Doyle**

PINE RIDGE - **Jacqueline Hill**

QSLMA - **Robert Sherk**

SAME - **Sumintra Koowar**

SWOAME - **David Petro**

TEAMS - **Pat Margerm**

WOMA - **John Ferguson**

Y^{4}MA - **Rosey Mastrofrancesco**

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