Submission of Articles

The *Ontario Mathematics Gazette* (*OMG*) is looking for news items, articles, and good ideas that are useful to mathematics teachers and mathematics teacher education. We are seeking submissions, preferably from mathematics teachers K–12 and other mathematics education professionals, that describe innovative and creative approaches to mathematics teaching.

Please keep in mind the following criteria when making submissions to the *OMG*:

- The ideas/activities must be of interest to the readership.
- The ideas/activities must be fresh and innovative.
- The mathematics content must be appropriate for the readership.
- The mathematics content must be accurate.
- The article must be well written and easily understood.
- The article and its ideas must be free of sexual, ethnic, racial, or other bias.
- The article must not have been previously published, nor should it be out for review by other publications.
- The article must be original.

Articles must be word-processed in MS Word, double-spaced with wide margins, not exceeding 10 numbered pages of text, and prepared according to the *Publication Manual of the American Psychological Association, Fifth Edition*. Figures and diagrams should be drawn by computer, if possible, or drawn in black ink in camera-ready form. Embedded images must also be submitted separately in jpeg or tif format. Proof of the photographer's permission is required, and for **photos of students** under the age of 18, the written permission of a **parent or guardian is required**.

You must submit **one complete copy** of your article, embedded with any tables, figures, and captioned photographs or graphics, to the Editor, Stewart Craven, along with **separate files for each of the text, graphics, and/or photographs**. Please e-mail all files to Stewart Craven at **numeratecitizen@mac.com**.

Your name should not appear anywhere in your article, including websites, so that your article can be sent out for blind review. Your name, full mailing address, and e-mail address must be included on a separate sheet. Upon review, you will be notified as to whether your article has been accepted for publication (as is, or pending minor or major revisions) or rejected.

The Editor reserves the right to edit manuscripts prior to publication. Once an article is published, it becomes the property of OAME.

PERMISSION TO REPRINT: Permission to reprint any part of this publication for instructional use or for inclusion in an affiliate or other publication must be obtained through the Editor, Stewart Craven. Full credit must be given to the author and to the *Ontario Mathematics Gazette*.

The views expressed or implied in this publication, unless otherwise noted, should not be interpreted as official positions of OAME.

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Submission of Advertisements

Advertisements for the *Ontario Mathematics Gazette* should be sent to **Robert Sherk** at the above address. Courier is recommended to avoid possible delays. Deadlines for advertisements are January 23 for the March issue, April 1 for the June issue, July 1 for the September issue, and October 1 for the December issue.

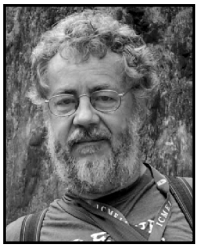
Full page advertisements are to be on 8.5" by 11" paper with a minimum of 0.5" margins and single sided. Each advertisement should be camera-ready and colour advertisements should have no bleeds.

Advertising Rates

Advertising Rates are available by telephoning, e-mailing, or writing to the Advertising Manager.

▲ Editor's Message

STEWART CRAVEN, EDITOR



As editor, I must admit that it was a very good feeling to see the September issue of the *Ontario Mathematics Gazette* in print. I recognize that this was the result of the combined efforts of the writers, reviewers, copy editor, proofreader, designer, advertising manager, OAME Executive Directors, and printer. May I extend my thanks to one and all.

For a very long time, I have been concerned about the fact that the majority of students who graduate from our schools do not have a very positive attitude toward mathematics. In fact, some could be described as outwardly hostile toward our subject—the "I hate mathematics" group—while others could be described as math phobic. I feel that this is a travesty. It is my contention that society needs "numerate citizens" who are able to confidently

- use mathematics in their day-to-day lives to make decisions that are, for example, environmentally appropriate and socially responsible
- inform their opinions by accurately interpreting numerical and graphical information presented in the media
- apply mathematics as required in their jobs or professions
- do (and enjoy doing) mathematics for recreational purposes
- enjoy the mathematically aesthetic aspects of both natural and constructed objects

Why, then, do so many people not embrace mathematics? Is it the very nature of the subject? Is it the curriculum? Is it how we teach mathematics? Is it a self-perpetuating vicious circle—math phobic/disinterested students become phobic/disinterested parents, who quite often inadvertently raise math phobic/disinterested children? It is, most likely, a combination of all of these factors and more.

There are, however, individuals in all walks of life who love mathematics. Some of these people are highly skilled in mathematics (e.g., professional

mathematicians), but there are many others who simply take great pleasure in solving mathematical problems and doing mathematics for enjoyment. We must seek out the influences that led these people to enthusiastically embrace mathematics. Was it that exhilarating "Aha!" feeling when one solves a challenging problem? Or was it discovering the amazing connections between such constructs as the Fibonacci sequence and natural phenomena, such as the arrangement of seeds in a sunflower? Perhaps it was the opportunity to solve problems with, and work with, like-minded individuals. Or perhaps the catalyst was the unparalleled beauty of a fractal image, or the ultimate elegance of Euler's equation $e^{\pi i} - 1 = 0$.

Is it possible to entice the majority of people to not only be curious about mathematics, but also to embrace it as a way of making sense of the world? Would it be possible to "brand" mathematics in such a way that even very young children, who almost universally recognize the McDonald's "Golden Arches" (my own daughter, at 15 months of age, would point and yell "Fries!" whenever the famous "M" came into view), would respond to a cleverly designed symbol/logo that would lure them into the marvelous kingdom of mathematics? Is "branding" mathematics an idea whose time has come? Perhaps this is something for all of us to ponder! ▲

▲ Call for Manuscripts

The *Ontario Mathematics Gazette* is inviting manuscripts for all grade levels.

Instructions for submission of manuscripts are found on page 1 of any *OMG*.

Contact the Editor for further details.

▲ President's Message

ANNA JUPP, PRESIDENT



Anna has been working as an Instructional Leader of Mathematics with the Toronto District School Board for the past 10 years. She supports K–8 teachers though the development and facilitation of professional learning opportunities, resource development, and consultation. Anna has contributed to various Ministry initiatives, including the Expert Panel Reports for the Early Math Strategy and Education for All. Anna is also a mathematics AQ course instructor with OISE and has been part of an author team for primary math programs. She has served as a Board Director since 2001 and 3 years as Vice-President before becoming President. Anna was the recipient of the 2005 Union Gas Award for Outstanding Leadership in Mathematics.

Change in Mathematics Instruction and Student Success: A Look at Both Sides of the Equation

Over the last several decades, we have experienced significant change in the way math is taught in North American, Canadian, and provincial educational systems. With this change has come criticism, bringing with it a spotlight on student achievement in mathematics on both sides of the border. Various stakeholders analyze and compare international test scores, standardized tests, and locally, EQAO results, to determine whether or not current teaching methods and curricula are enabling students to compete in our modern world. They ask: *Are our students measuring up?*

Math reform itself was a subject of discussion in our recent federal election campaign in Canada and in the presidential campaign in the United States. Political candidates questioned test scores, dropout rates, and current teaching methods, and accused opposing parties of not doing enough. In one of his campaign speeches, Barack Obama identified knowledge as the most valuable skill, but in the same address, claimed that American schools are failing children when it comes to math and science.

On this side of the border in Ontario, we don't have to be in the midst of an election for media outlets to report

on poor results in math, despite the implementation of specific strategies. One recent newspaper article questioned why EQAO math scores have not improved significantly, despite a provincial reduction in class size and increased taxpayer funding, and talk has surfaced again about a back-to-basics approach to teaching in an attempt to solve our math woes.

While the emphasis has remained on what is *wrong* with mathematics education in Ontario and beyond, it is time for us, as math educators, to take the reins, take action, and educate the public about what is right with it. At OAME, it is our vision that "the learning of mathematics is supported through the active and ongoing involvement of students, parents, educators, and the community at large."

Let us focus on—and inform the taxpayer about—the success stories that change has brought about in mathematics education. More and more students are learning in an environment where they do, see, hear, and touch mathematics in a profound and meaningful way. Classrooms have become communities where teachers and students work collaboratively to learn and value mathematics, and formal rules and methods are being learned in rich, problem-solving contexts, where students use and apply their knowledge meaningfully.

As educators, we are studying, researching, and implementing strategies that will help all students—including ESL students, English Language Learners, and students with special needs—succeed in mathematics. Various technologies are being used in math classrooms, not only as tools for learning, but also to prepare students so that they can successfully participate as numerate citizens in a modern, competitive world. And yes, Canadian students are out-scoring American students in international math tests!

It is crucial, however, that we not only inform the public about the successes of our current math instruction practices, but that we provide feedback, give input, and advise as well. Our voice—the OAME vision—must be heard in order to influence Ministry of Education policies and initiatives in mathematics. I challenge you to join advisory panels and feedback groups, complete surveys and questionnaires, and participate in discussion forums and councils when these opportunities are presented. Through dialogue, parent information sessions, Family Math nights, parent-teacher conferences, and with the help of students themselves, we must continue to advocate for the type of math learning and resources required for continued and sustained success in mathematics education in Ontario.

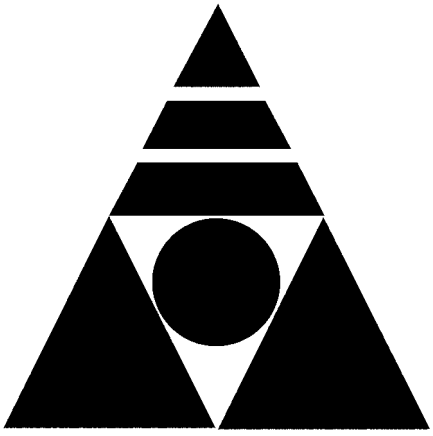
As educators, it is our responsibility to establish the course so that we can all share in the triumph of students who have come to learn, value, and succeed in mathematics. ▲

OAME LEADERSHIP CONFERENCE 2009
FEB 19-21, 2009, IN TORONTO

DEVELOPING PERSPECTIVES ON LEARNING AND TEACHING MATHEMATICS

An opportunity for teacher leaders, co-ordinators/consultants and administrators to investigate ways to make connections in elementary or secondary mathematics by focusing on one of the following:
Grades K–8: Developing Algebraic Thinking. Workshop leader: Dr John Mason
Grades 7–12: Connecting Practice, Research, and People. Workshop leaders: Myrna Ingalls, Irene McEvoy

Registration deadline: Jan 15, 2009



Visit www.oame.on.ca for full details and the registration form

CARTOON CONTEST

Create a cartoon based on a mathematical object or concept (1, 2, 3, or 4 frames)

Winning entries will be published in the Gazette

All artwork and captions must be original.

OPEN TO: Group #1 - any elementary school student
Group #2 - any secondary school student

GROUPS JUDGED SEPARATELY: Winning entries will be published in the *Ontario Mathematics Gazette* starting with the June 2009 issue (and in the subsequent 4 issues).

DEADLINE FOR SUBMISSIONS: March 31, 2009

SUBMIT ENTRIES as jpegs to: Stewart Craven at **numeratecitizen@mac.com**
Or by mail to: Stewart Craven, 118 Gledhill Avenue, Toronto, ON, M4C 5K8

ENTRIES MUST INCLUDE: Student Name, Grade, Present Teacher, Student Contact Information, School and School Address/Phone Number

NOMINATIONS FOR OAME/AOEM BOARD OF DIRECTORS 2009-2010

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. OAME/AOEM members running for Director will declare their intent to work on either Grade JK–6 or Grade 7–12 issues, based on their personal experience, expertise, and interests.

Nominations for these positions are to be submitted by 4:00 p.m., January 16, 2009, to:
Jacqueline Hill, Past-President

Include the nominee's qualifications with the Nominations Form. A nominee must be a member of OAME. By March 2009, the Nomination Committee will publish a slate of candidates on the website, including qualifications, for consideration by the membership.Voting will be on the website, and is open to all OAME/AOEM members. The election results will be released at the Annual General Meeting of the OAME/AOEM in Ottawa, May 2009.

NOMINATION FORM

I nominate _____

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

If for Director, area of personal experience/expertise, interest: ☐ Grades JK–6 or ☐ Grades 7–12

Nominee's Address: _____

_____

E-mail: _____

Telephone: H (____) _____

W (_____) _____

Nominator's Name : _____

Nominator's Address: _____

_____

E-mail: _____

Telephone: H (____)_____ W (_____)_____

▲ Technology Corner – Multiple Versions with Excel

MARY BOURASSA

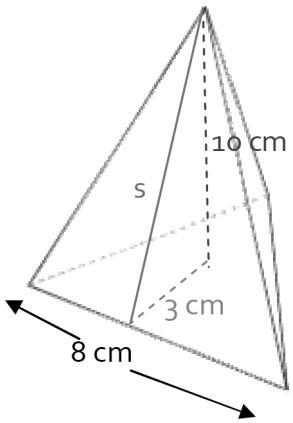


Mary Bourassa teaches mathematics at Lisgar Collegiate Institute in Ottawa. She is a strong advocate for the appropriate use of technology in the classroom. She was also Past-President of COMA, gives workshops around the world, and is a National Instructor for Texas Instruments.

Multiple Versions with Excel

Group work can be a wonderful thing for students; it allows them to learn from each other and to tackle more challenging problems together. When my students work together, each student is quite often looking at a unique version of the same question, so each student must do his or her own work. Teachers tend to shy away from multiple versions of a problem because it requires creating a marking key for each version. However, technology can help in this respect. Whether you need four versions of a problem so that each member of a group has a different question, or you want each student in your class working with different data, it can be easily done. If you set up a spreadsheet with formulas for each part of the solution, you can create as many versions as you like, and the answer key will be a snap!

Here is a sample question and its solution: *Determine the surface area of a triangular pyramid, given that the side length is 8 cm, the apothem is 3 cm, and the vertical height is 10 cm.*



Find the slant height, s, first.

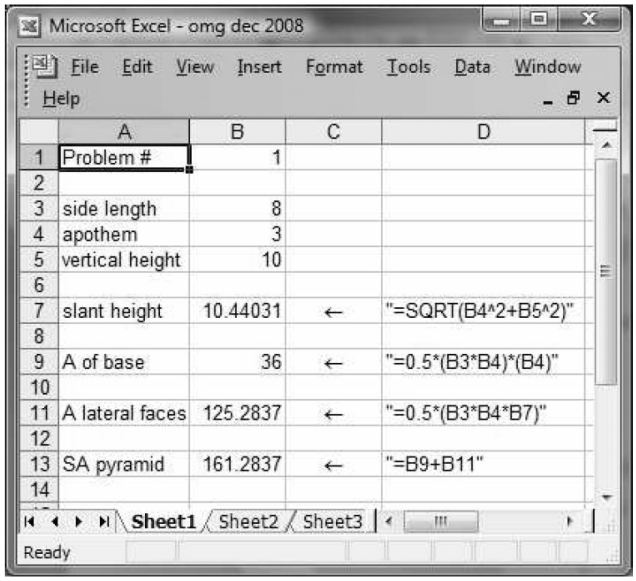
$$s = \sqrt{3^2 + 10^2}$$
$$= \sqrt{109}$$
$$= 10.44 \text{ cm}$$

$$A_{\text{base}} = \frac{1}{2}Pa$$
$$= \frac{1}{2}(8 \bullet 3)(3)$$
$$= 36 \text{ cm}^2$$

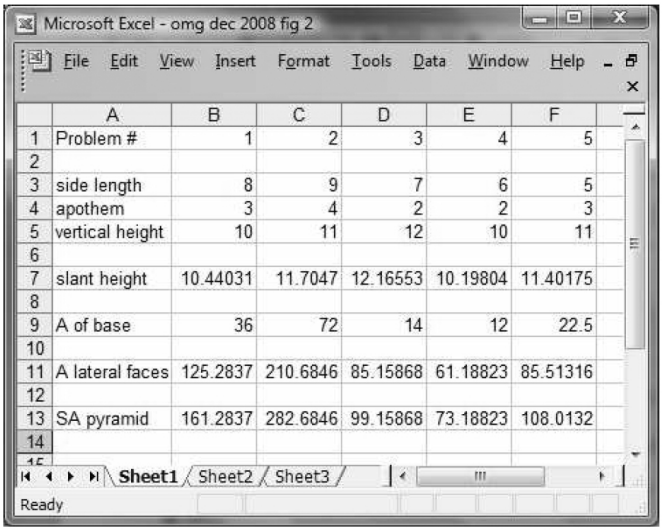
$$A_{\text{lateral faces}} = \frac{1}{2}Ps$$
$$= \frac{1}{2}(8 \bullet 3)(10.44)$$
$$= 125.28 \text{ cm}^2$$

$$SA_{\text{pyramid}} = 36 + 125.28$$
$$= 161.28 \text{ cm}^2$$

To set up this problem in Excel, enter the given data in cells B3, B4, and B5, as shown. The formula for each component of the solution is also shown, but should be entered without the quotation marks.



From this point, all you need to do is create different "problems" by changing the values of the side length, apothem, and vertical height. Copy the four formulas from cells B7, B9, B11, and B13, and the new answers for your new problem sets will appear!



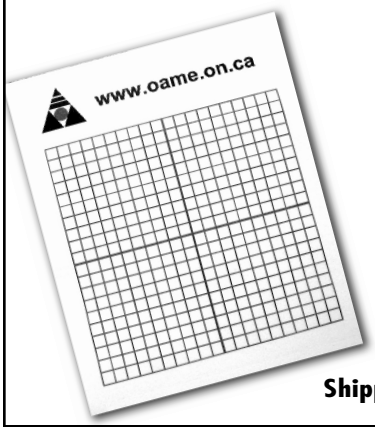
	A	B	C	D	E	F
1	Problem #	1	2	3	4	5
2						
3	side length	8	9	7	6	5
4	apothem	3	4	2	2	3
5	vertical height	10	11	12	10	11
6						
7	slant height	10.44031	11.7047	12.16553	10.19804	11.40175
8						
9	A of base	36	72	14	12	22.5
10						
11	A lateral faces	125.2837	210.6846	85.15868	61.18823	85.51316
12						
13	SA pyramid	161.2837	282.6846	99.15868	73.18823	108.0132
14						

You could even set up the problem using a formula. For example, each cell for side length could be 1 unit more than the previous one.

You can apply this same principle to any number of problems, at any grade level. As long as you can set up an algorithm for the solution, you can create as many different versions as you need. There is an added benefit to this system: If a student makes an error at Step 2, for example, you can create a new problem with the value the student obtained at that step, and quickly check that the rest of the process was correct, without having to work through the solution.

Enjoy doing group work with your students! ▲

OAME STICKY GRAPH PADS



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3 colours, 2.5" x 3"
50 sheets per pad
$9.00
for 10 pads

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or Order online www.oame.on.ca
Do not send cash or cheque. You will be invoiced with shipping and handling costs added.

▲ OAME/NCTM Report December 2008

LAURIE MOHER

Laurie is an Instructional Coach Facilitator for Literacy and Numeracy (JK–8) with the Kawartha Pine Ridge DSB. She has served on the Board of Directors of OAME for 12 years.

Affiliate Rebate Program

Did you know that every time a new member joins NCTM online, or renews an NCTM membership online and selects OAME as the "affiliate," OAME receives cold hard cash? Here's how it works. When an individual joins NCTM or renews a membership online, he or she is given the opportunity to select an affiliate to receive the rebate. Each time that OAME is selected as the affiliate, OAME receives $3 for a renewed membership and $5 for a new membership. So encourage your friends to join NCTM or to renew their memberships online and to select OAME as the affiliate! (This offer does not apply to K–8 school memberships and works only with online transactions.)

NCTM Website Resource Highlights

While strolling along the blue navigation bar on the NCTM home page, I found a wealth of information and resources. Here is a sampling of what can be accessed from that page.

In the Standards and Focal Points area, there are links to the *Principles and Standards for School Mathematics* materials. Membership is required for full online access, but some of the resources are free. This section also contains links to the "Curriculum Focal Points." The Focal Points are "the most important math topics for lasting learning at each grade level, Pre-K–8." This section includes the Focal Points by grade, a Q & A section, and free downloads.

In the Professional Development area are resources that link directly to NCTM's PD Focus of the Year, which for 2008–2009 is "Equity: All Means All." Resources are designed for use at the Elementary, Middle School, or High School levels. At the bottom of this page are sections entitled "Focus of the Year Resources," "Online Resources," and "Enhanced Articles." These provide links to article abstracts, print resources, and sample lessons. A membership is required to access many of the

articles, but the lessons are available to all.

The Lessons and Resources area is also organized around three levels (Elementary, Middle School, and High School). In this section, one can find a weekly problem and links to previous problems. There are also links to the Curriculum Focal Points (by grade level) in this area.

One final area of interest is Research, News, and Advocacy. This area contains research summaries, research briefs, news releases, and advocacy resources.

NCTM Members-Only Highlights

With an NCTM membership, you receive the following benefits:

- online access to the journal(s) to which you subscribe
- full access to *Principles and Standards for School Mathematics*
- access to "Calendar Problems," "Student Math Notes," and "The World's Largest Math Event" resources
- access to ON-Math (Online Journal of School Mathematics)
- 15 free article downloads from non-subscribed articles
- conference discounts and discounts on workshops and NCTM publications

If you have not checked out the NCTM website recently, take a stroll along the blue navigation bar or through the "Members Only" section, and enjoy the many resources that can be found there. Then encourage your friends to join NCTM or renew their memberships online, choosing OAME as the selected affiliate! ▲

▲ Vote Online

To elect Executive and Directors for the OAME Board of Directors, please vote online at **www.oame.on.ca** from **Mar 1- Apr 15, 2009**. Click on Members Only to activate your account if you have not already done so. If you require a written ballot, please contact in writing by Feb 1, 2009:
Dave and Sue Hessey, Exec. Directors
70 Chestnut Crt. London
ON N6K 4J5

▲ What's the Problem? Pretty Pythagorean Problem

SHAWN GODIN



Shawn is the head of Mathematics, Business and Technology at Cairine Wilson S.S. in Orleans, ON.

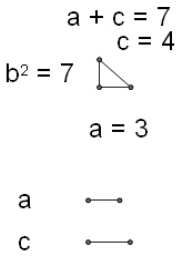
Welcome back, problem solvers! Last issue, I left you with the following problem:

> *The right triangle having sides 3, $\sqrt{7}$, and 4 has the strange property that the two integer lengths sum to the value under the square root sign for the length of the third side. Find another such triangle.*

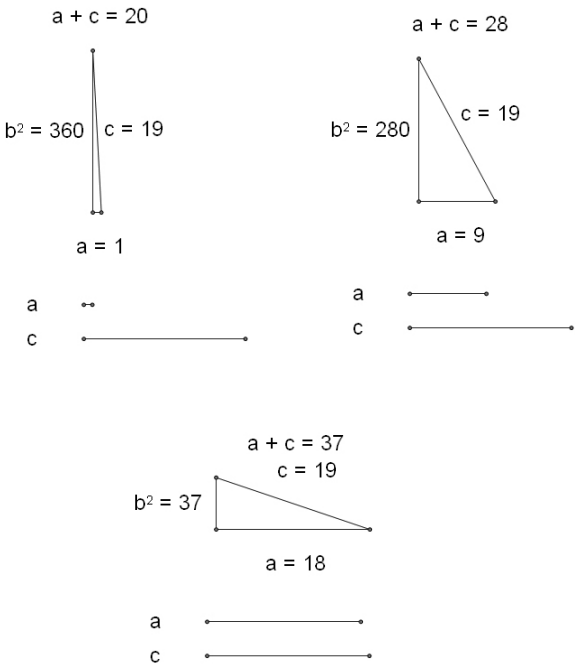
This problem appeared as M291 from the April 2007 issue of *Crux Mathematicorum with Mathematical Mayhem*, and its solution appeared in the April 2008 issue. You can check out more problems at the *Crux Mathematicorum with Mathematical Mayhem* website: **http://journals.cms.math.ca/CRUX**.

As with many mathematical problems, it's a good idea to play around and see whether you can find an answer. You could use a pencil, calculator, and paper, or a spreadsheet to explore the problem. My investigation started by creating a sketch in *Geometer's Sketchpad*™.

My sketch has two sliders that produce whole-number lengths for the hypotenuse and one leg. It then displays the square of the other side, as well as the sum of the hypotenuse and the leg you have set. The desired triangles have $b = \sqrt{a + c}$, or, $b^2 = a + c$. Below is a screenshot of the sketch, showing the triangle from the original problem. (The sketch is available on the OAME website at **www.oame.on.ca**.)



If we choose a random length for c, and we start manipulating a, we notice a pattern. When a is small, b^2 is quite large, and as a gets larger, b^2 gets smaller. In my case (see below), we find a triangle with sides 18, $\sqrt{37}$, 19 that satisfies the conditions of the problem. Yes! We're done… or are we?



One of the things that mathematicians do is solve problems, reflect on their answers, and look for a bigger picture. This question asked for one more solution, yet the one that I found had one leg one unit shorter than the hypotenuse, just like the example. The question that you should be asking is, "Is there something bigger going on here?" If we explore other lengths for the hypotenuse, we find that, in every case, if one leg is one unit shorter than the hypotenuse, we have a triangle that satisfies the conditions of the problem. Now we have a conjecture: If one leg of a right triangle is one unit shorter than the hypotenuse, it has the desired property. In other words, if $a = c - 1$, then $b = \sqrt{a + c}$.

The next step that the mathematician takes is to try to prove his or her conjecture. We now move to a more abstract representation of the problem. Recall that the Pythagorean theorem can be stated in algebraic form as $a^2 + b^2 = c^2$, where a and b are legs of a right-angled triangle and c is the hypotenuse. This can be restated as $c = \sqrt{a^2 + c^2}$, since c is a length, and thus, we are interested only in positive solutions. If we consider triangles in which the legs both have integer length, then to satisfy the condition, we would have to have $a^2 + b^2 = a + b$. The only solutions to this, in non-negative integers, are: $a = 0$, $b = 0$; $a = 1$, $b = 0$, and $a = 0$, $b = 1$, which are degenerate triangles, and $a = 1$, $b = 1$, which leads to another solution: 1,1, $\sqrt{2}$.

If we look at a triangle where one of the legs and the hypotenuse have integer length, we get a right triangle with legs a and $b = \sqrt{a + c}$ and hypotenuse c. Substituting this into the Pythagorean theorem and doing some algebraic manipulation, we get:

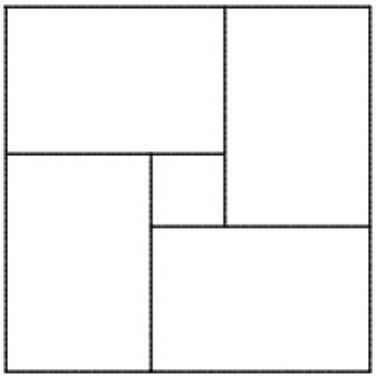
$$a^2 + (a + c) = c^2$$
$$a + c = c^2 - a^2$$
$$a + c = (c + a)(c - a)$$

Since a and c are lengths of sides in a non-degenerate triangle, they are both positive and $c > a$. Thus, $a + c \neq 0$, and since $a + c = c + a$, we can divide our equation above and get $1 = c - a$ or $a = c - 1$, just as we conjectured. The proof is now complete. We have shown that, in order to satisfy the conditions of the problem, our triangle must have the side lengths that we conjectured. We also found one extra case that, by the wording of the problem, we might have missed.

It is interesting to note that this is not the only acceptable proof. Instead of factoring the difference of squares, we could have gathered the terms involving a on one side, and those involving c on the other. See if you can complete the proof by using this method or by using a totally different technique.

Now, for your homework!

Four congruent rectangles are arranged in a square pattern so that they enclose a smaller square. Let S be the area of the outer square and Q the area of the inner square. If the area of the outer square is 9 times the area of the inner square, determine the ratio of the sides of the rectangles.



Until next time, happy problem solving! ▲

RECOGNIZE AN EXCEPTIONAL LEADER IN MATHEMATICS EDUCATION



The purpose of the Ontario Association for Mathematic Education's Awards is to formally recognize individuals who demonstrate an outstanding contribution to mathematics education in Ontario. The successful candidate enhances the learning environment, providing opportunity for students to do, see, hear and touch mathematics in a profound and meaningful way. If you know someone who qualifies for this honour, please nominate her/him.

OAME/AOEM Awards Nomination Process

1. Complete the Award Nomination Cover Page on the next page or contact the Executive Directors for an electronic version (oame.hessey@sympatico.ca). You may include a one-page letter of recommendation.
2. Provide up to 3 letters of support, of no more than 2 pages each. These supporting documents may be gathered from a variety of sources to reveal a full picture of the nominee. The support documents will provide precise information about the nominee's contributions as they relate *primarily* to the specific award. You may also include the following areas for consideration:
   - demonstration of excellence and creativity in mathematics education
   - leadership in mathematics education in the school, region and province
   - support of and involvement in OAME/AOEM
   - contribution to the development of students both within and outside of the classroom
   - additional relevant information not specifically mentioned
3. Include the nominee's Curriculum Vitae of up to 5 pages.
4. Send the completed cover page and supporting documents to: Dave and Sue Hessey
5.

Deadlines: Nominations are due by January 31, 2009. The awards will be presented at the Annual Conference in May, 2009.

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

OAME AWARDS

OAME/AOEM Life Membership Award recognizes an educator who has contributed in a significant way to OAME/AOEM; demonstrates outstanding leadership in mathematics education; and has accumulated 10 or more years of membership in OAME/AOEM.

Award for Outstanding Contribution to OAME/AOEM and Mathematics in Ontario recognizes an individual who has made a 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 recognizes an exceptional and creative elementary teacher who demonstrates excellence in mathematics education and contributes to the overall development of students.

Award for Exceptional and Creative Teaching in Secondary Mathematics recognizes an exceptional and creative secondary teacher who demonstrates excellence in mathematics education and contributes to the overall development of students.

Award for Leadership in Mathematics Education recognizes an educator who has demonstrated leadership by contributing in a significant way to the development of mathematics teachers and enhancing mathematics education in Ontario.

Kenneth D. Fryer Award* recognizes a mathematics department that fosters collegiality, teamwork, and excellent classroom teaching; contributes to the overall development of students; and demonstrates leadership in the mathematics education community.

*This award was established in memory of the late Kenneth D. Fryer and is co-sponsored by the Grand Valley Mathematics Association. Curriculum Vitae not required.

AWARD NOMINATION COVER PAGE

INTENDED AWARD *(please check one)*

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

Nominee's Information:

_____

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

_____

_____

School, Organization, or Business Address

Tel: ( ) _____ Fax: ( ) _____

Home Address: _____

_____

Home Phone: ( ) _____

E-mail: _____

Nominator's Information:

_____

Name of Nominator

_____

_____

School, Organization, or Business Address

Tel: ( ) _____ Fax: ( ) _____

Home Address: _____

_____

Home Phone: ( ) _____

E-mail: _____

SEND with supporting documents by Jan 31 to:
Dave and Sue Hessey, Executive Directors

Contact the Executive Directors for an electronic copy of this form.

▲ Data Rocks – New Math Resources from Statistics Canada

Angela McCanny

Elise Mennie

Joel Yan



Angela McCanny is a mathematics educator currently working for Statistics Canada. Over the past three years, she has visited more than 250 classrooms, helping teachers find exciting resources for teaching math and social sciences.

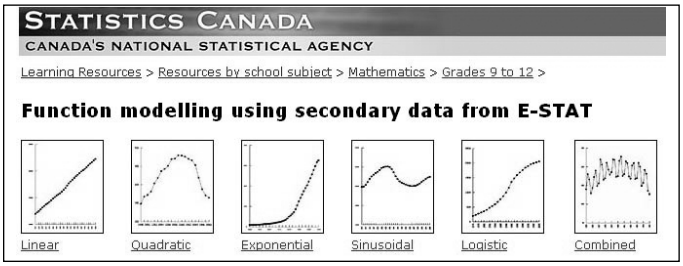


Elise Mennie is Communication Manager for Statistics Canada's Education Outreach program. She produces a monthly e-bulletin for teachers on Statistics Canada Learning Resources for teachers. See www.statcan.ca/english/edu/news.htm.



Joel Yan has been part of the Education Outreach Team at Statistics Canada in Ottawa for 15 years. As a mathematician, he is passionate about developing StatCan resources for math and helping teachers use these resources with their classes. He recently succeeded in getting the CCHS microdata licensed by the Ontario Ministry of Education.

New Resources To Teach Function Modelling Using Real-World Data (Grades 9–12)



Statistics Canada has improved our *function modelling* teacher resources through the inclusion of:

- five new datasets that are best modelled by the combination of different types of functions (quadratic + sinusoidal, linear + sinusoidal, linear + exponential) to meet the needs of the Grade 12 Advanced Functions course
- a total of 35 datasets that can easily be modelled by the mathematical functions shown above
- six complete modelling lessons, in English and in French, for applying these datasets in the classroom
- clear instructions for retrieving the datasets from E-STAT and applying them in the classroom
- a temporary E-STAT account and password that teachers can use to have immediate access to these datasets

For details, see **www.statcan.ca/english/edu/mathmodel.htm**.

The activities for modelling exponential and sinusoidal functions were very effective with my Grade 12 college-level classes. Students experienced a real 'Aha' moment as they used dynamic data analysis software to carry out these activities: They could observe how their adjusting of a function's parameters would immediately affect the shape of the curve. This greatly enhanced their understanding of the role of each parameter in the mathematical function.
– Bill Schroeder, secondary mathematics teacher, Barry's Bay, Ontario

Health Microdata for MDM4U Classes

The CCHS (Canadian Community Health Survey) Microdata from Statistics Canada, featured in the September 2008 issue of the *Gazette* (pp. 29–31), should now be in your schools, and hopefully, in the hands of Data Management teachers.

Ten narrated video tutorials on how to use this rich microdata file with the *Beyond 20/20* software are now available through the OAME website at **www.oame.on.ca**. Just look for the heading "New microdata source provincially licensed!" For detailed information on teacher-support resources and teacher training, see the September issue of the *Ontario Mathematics Gazette*.

Data Analysis Projects and Fairs: A "How-To" Guide



Since the introduction of the MDM4U Data Management course, Statistics Canada has been involved in helping students find interesting and relevant data for their culminating investigations. Data analysis fairs that showcase exemplary student projects have also gained popularity across Ontario. After five years of involvement, Statistics Canada has created a new website section designed to help students and teachers share their experiences and their knowledge regarding data projects and fairs. It offers information to help:

- students find and interpret data for their investigation
- educators organize a data fair in their region

To help with data-analysis projects, we offer tips on creating your own survey for the purpose of collecting primary data, as well as guidance on how to search for secondary data on the Statistics Canada website. You'll also get help with using the data through resources relating to data concepts and analysis tools.

If you're wondering how to organize a Data Fair, look no further! You'll find articles, example projects, judging criteria, and more from data fairs across Ontario. Find it at **www.statcan.ca/english/edu/edu06i_0000-en.htm** or go to **www.statcan.ca/english/edu** > Quick links: Resources by school subject > Mathematics > Grades 9 to 12.

Listen Up! Data Analysis Podcasts



This section features informal audio learning files that you can listen to from your computer, download and save, or transfer to an MP3 player. If you prefer, you can also read the complete transcript or the brief summary.

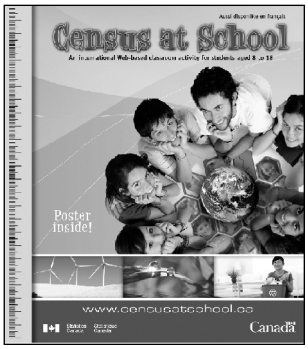
Find data for your project

Learn about students' data analysis projects

For the plugged-in student, we have posted lively audio podcasts on how to find data for projects. Take the time to listen to the student interviews recorded live at the 2008 Statistics Canada Data Analysis Fair. It's interesting to listen to students talk about how they gathered their information and how eager they were to analyze the information and find the stories that lay in the data.

Census at School In-Class Survey: New Data and New Lessons on the Environment

Census at School is an online survey project that teaches students about collecting, handling, and interpreting data. This project fits well with the following Ontario curricula: Grades 4 to 8 – Data Management and Probability, Grade 9 – Academic and Applied, Grade 12 – College and Apprenticeship and Mathematics for Everyday Life.



Last year, close to 30 000 Canadian elementary and secondary students participated in the *Census at School* online survey at **www.censusatschool.ca**. Teachers who get their classes involved are able to access their own class data to use in teaching about graphs, percentages, and statistics. Students love to compare their own class data to Canadian results!

Note: *You can order* Census at School *posters on the environment or enquire about classroom workshops available in Ottawa, Toronto, and southern Ontario (London area) by contacting Sandra McIntyre, Ontario regional education representative, at* ***sandra.mcintyre@statcan.ca****.*

Census at School survey questions on the **environment** provided interesting results in last year's 2007–2008 survey:

- The importance that students attributed to recycling diminished steadily as they grew older (from 8 years of age to 15 years of age), while the importance they attributed to owning a computer increased steadily as they grew older.
- Among participating elementary students, the importance of reducing pollution ranked highest, on average, in Quebec and Prince Edward Island.
- Among participating elementary students, the importance of conserving water ranked the highest, on average, in Alberta and British Columbia.

See these and other results in the **Data and Results** section of **www.censusatschool.ca**.

My students got more out of this project than any textbook or teacher could communicate.
– Larry Scanlon, primary–intermediate special education teacher, Waterloo, Ontario

New

Two new lessons on the environment help students compare class data and Canadian data on recycling:

- *Canada Recycles – Do You?* worksheets for Grades 4 to 6 and Grades 7 and 8.
- *Recycling in Canada* for Grades 9 to 12

Below are selections from the student worksheets for these lessons, which are available at **www.censusatschool.ca** under "Learning Activities."

(Grades 4–6) Canada Recycles! Do You?

How does your class care for the environment?

1. Use your class *Census at School* database to fill in the chart for your class:

How many students in your class…?	Recycle:			Compost	Use any compact fluorescent bulbs
	Metal Cans	Plastics	Paper		
Number of students					

2. On graph paper, make a **bar graph** with the information for your class. Remember to include a title, scale, and labels for the axes.

Use the graph for *your class* to answer these questions:

3. Circle the type of material that is being recycled by the most student households:

   Metal Cans Plastics Paper

4. In what activity does the lowest number of student households participate?

   _____

   _____

5. What changes could your class make to help our environment be healthy?

   _____

   _____

6. What could you do differently, at home and at school, to care for the environment?

   _____

   _____

(Grades 7–8) Canada Recycles! Do You?

From 1994 to 2006, the percentage of households in Canada that recycled, or did other things to save energy and save our planet, increased by about 25%.

Examine the table to see how many Canadian households are helping our environment:

EARTH-FRIENDLY ACTIVITIES IN CANADA, 1994 AND 2006

	Households that recycled:			Households that composted	Households that used any compact fluorescent bulbs	Main type of drinking water consumed	
	Metal cans	Plastics	Paper			Tap water	Bottled water
Canada 1994	56%	52%	58%	23%	19%	No data	No data
Canada 2006	81%	84%	83%	27%	58%	58%	29%

Source: Statistics Canada, Households and the Environment Survey, 1994 and 2006

Use the preceding table to answer the following questions:

1. Circle the type of material that was being recycled by the greatest percentage of Canadian households in 2006:

   Metal cans Plastics Paper

2. From 1994 to 2006, what was the increase in the percentage of households that composted?

   Percent: _____

   Express as a fraction in lowest terms: _____

3. In 2006, what percentage of Canadians used at least one compact fluorescent light bulb in their home?

   _____

   _____

4. There were approximately 12 437 470 households in Canada in 2006. **How many** of them used at least one compact fluorescent light bulb? Show your work.

   _____

   _____

5a. Do more Canadians drink tap water or bottled water?

   _____

   _____

5b. Do you think that drinking tap water or bottled water is a better choice for the environment? Explain your reasoning.

   _____

   _____

   _____

   _____

Compare your class to Canada!

6. Use your class *Census at School* database to find the percentage for your class in each of these categories:

	Households that recycled:			Households that composted	Households that used any compact fluorescent bulbs	Main type of drinking water consumed	
	Metal cans	Plastics	Paper			Tap water	Bottled water
Your class%							

7. On graph paper, make a **double-bar graph** to compare the **2006 Canadian data with your class data** for each of the categories in the table. Remember to include a title, as well as an appropriate scale and labels for the axes.

_____

_____

(Grades 9–12) Recycling in Canada

Consider the total amount of waste produced by the products we consume.

When households report that they recycle, this does not mean that they are recycling 100% of their recyclable garbage. Consider, also, that a large proportion of the total waste per person in Canada is created during the production, transportation, and packaging of the goods that we buy and use.

In fact, 66% of all waste is generated outside our homes, in places such as schools, hospitals, and workplaces, and on the street, in malls, and in industry. For this reason, we do not have personal control over our portion of the total waste created. We must recycle our own consumer waste and be aware that manufacturers, wholesalers, and retailers are also responsible for recycling the waste created to produce and distribute the goods we consume.

Let's try to get a better picture of the total amount of residential waste produced and recycled in Canada. The following table shows how many kilograms of residential waste were produced per person and how much waste was diverted from landfill sites through recycling in 2006. It also shows the percentage of households that used any type of recycling program in 2004.

Definitions

Waste disposed: waste that is put into landfill, incinerated, or treated for final disposal (does not include materials destined for recycling and composting)

Recyclable materials diverted: materials diverted from the waste stream and remanufactured into a new product or used as a raw material substitute

Total materials discarded: the combined total amount of waste disposed and recyclable materials diverted

DISPOSAL AND DIVERSION OF RESIDENTIAL WASTE AND HOUSEHOLD USE OF RECYCLING PROGRAMS, BY PROVINCE AND TERRITORY, 2006

	1	2	3	4	5
	Total residential waste disposed per capita	Residential recyclable materials diverted per capita	Total materials discarded per capita (Column 1 + Column 2)	Diversion rate	Households that used any recycling program in 2006
	Kilograms per capita			Percent %	
Newfoundland and Labrador	446	X			82
Prince Edward Island	X	X			98
Nova Scotia	181	149			95
New Brunswick	289	44			83
Quebec	285	122			86
Ontario	292	119			93
Manitoba	386	60			79
Saskatchewan	300	39			87
Alberta	289	98			85
British Columbia	222	145			93
Yukon	214	X			-
Northwest Territories	347	X			-
Nunavut	X	X			-
Canada	**283**	**115**			**90**

Use the table to answer the following questions:

1. Which province disposed of the greatest amount of residential waste per person?

   _____

   _____

2. Which provinces recycled the greatest amount of residential materials per person?

   _____

   _____

3. For each region, calculate the total amount of materials discarded per capita, including waste disposed and materials recycled.

   Total materials discarded per capita = *Column 1 + Column 2*

   Record your answers in Column 3 of the table

4. For each region, calculate the diversion rate formula (the amount of residential materials recycled, compared to the total amount of residential materials discarded), using the following formula:

$$\text{Diversion rate} = \frac{\text{Column 2}}{\text{Column 3}} \times 100$$

Record your answers in Column 4 of the table.

5. Which province had the highest diversion rate?

   _____

6. Do you think there is a connection between the diversion rate and the percentage of households that use a recycling program in the provinces and territories? Explain your answer.

   _____

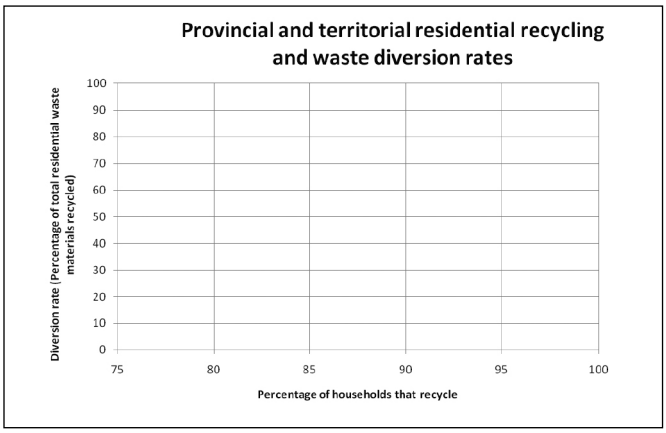
   _____

   _____

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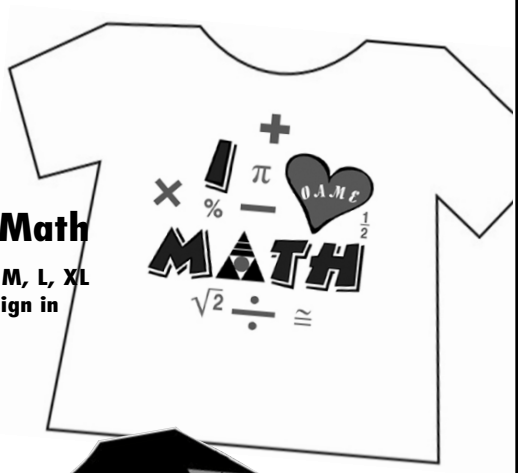
Graph the results and answer the questions that follow.

Create a scatter plot below to compare the percentages of households that used a recycling program (Column 5 from the table above) with the diversion rates (Column 4). Identify each data point by labelling it with the provincial or territorial abbreviation (e.g., MB for Manitoba, NB for New Brunswick).



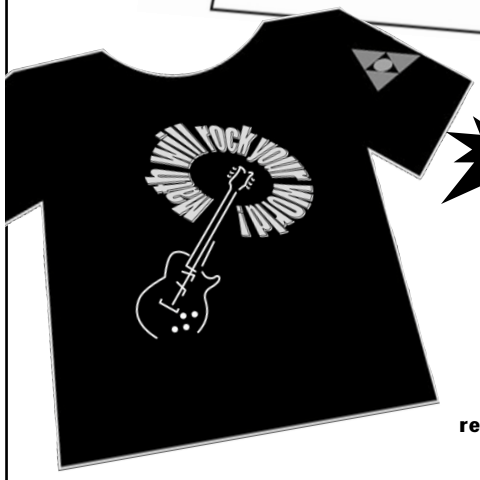
7. Draw the line of best fit (the trend line that fits the majority of data points) for the above graph.
8. Describe the trend in the graph. Does this match your prediction in Question 6?
9. How can you explain the connection between the percentage of households that recycle and the diversion rate?
10. What changes could be made in provinces and territories with lower diversion rates and lower percentages of households involved in recycling in order to improve both of these areas? Consider the responsibilities of governments, industries, and individuals in your answer. ▲

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OAME Financial Statement 2007/08

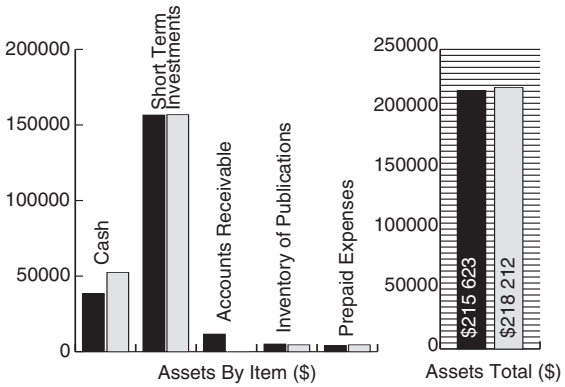
Notice to Readers

I have compiled the Balance Sheet of the Ontario Association for Mathematics Education (Association Pour L'Enseignement Des Mathematiques) as at August 31, 2008 and the Statement of Operations and Operating Fund Balance for the year then ended, from information provided by management. I have not audited, reviewed or otherwise attempted to verify the accuracy or completeness of such information. Readers are cautioned that these statements may not be appropriate for their purposes.

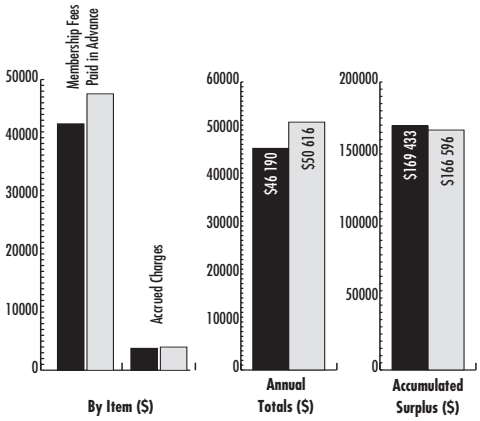
London, Canada September 18, 2008, PHILIP J. GRIFFIN Chartered Accountant

2008/2007

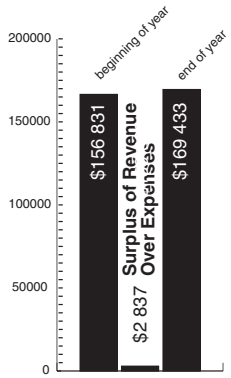
Current Assets



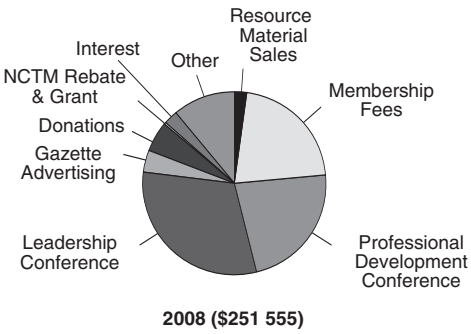
Liabilities and Fund Balance



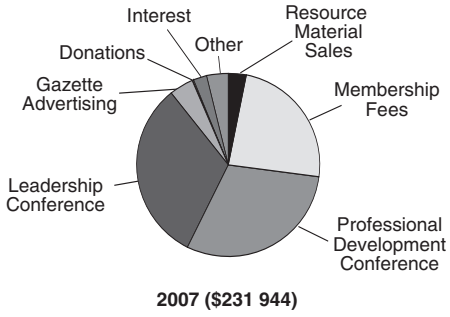
Operating Fund Balance



Revenue

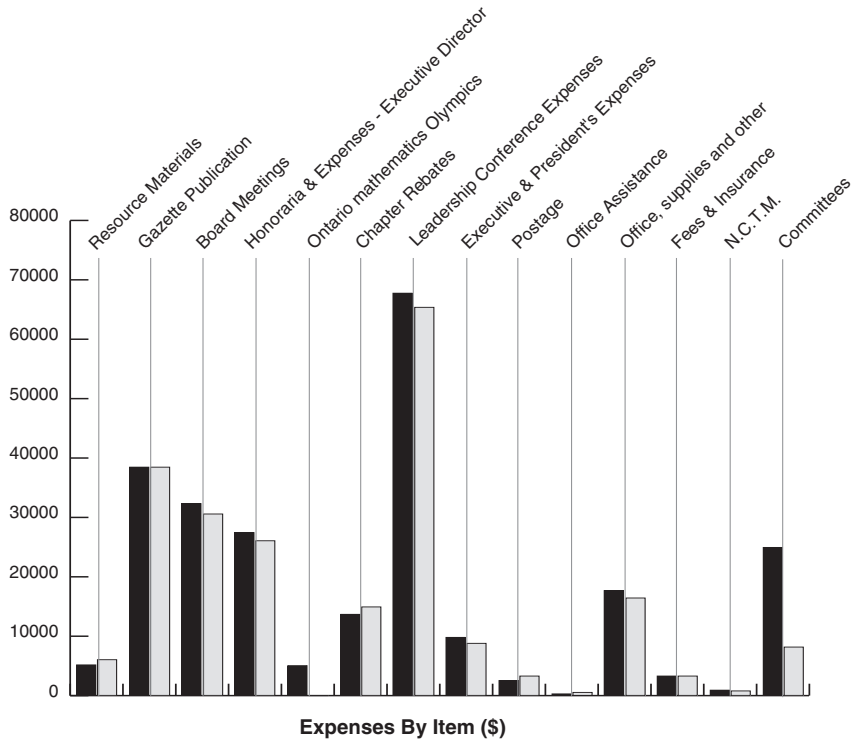


2008 ($251 555)



2007 ($231 944)

Expenditures

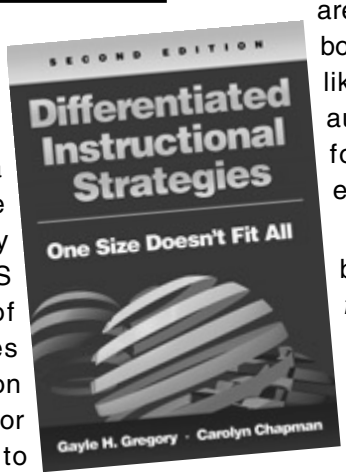


▲ Book Review: A Three-Book Study Of Differentiated Instruction

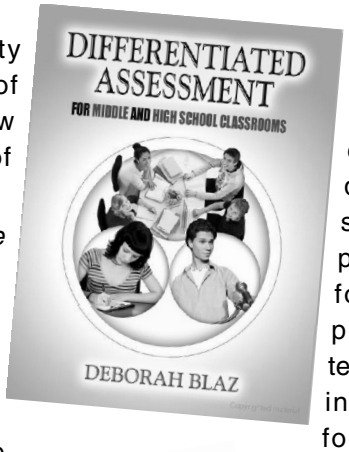


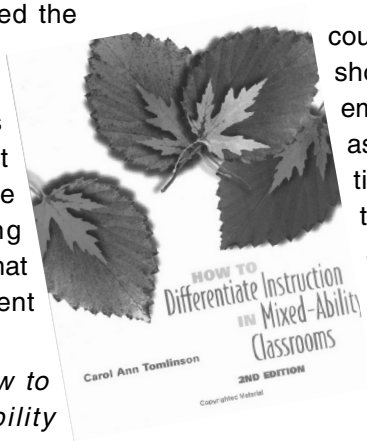
REVIEWED BY SUE MELVILLE AND THE MATHEMATICS EQUITY COMMITTEE

OAME's *Vision for Learning Mathematics* states that we "envision a learning environment where all students do, see, hear, and touch mathematics in a profound and meaningful way." One function of the OAME Mathematics Equity Committee, as described in OAME'S Constitution, Bylaws, and Terms of Reference, is "to monitor equity issues within the field of mathematics education and, where feasible, to take action and/or make recommendations to the Board to promote equity in mathematics education." It was with this function in mind that the Equity Committee embarked on a three-book study of differentiated instruction. We wanted to know how differentiated instruction supports the vision of OAME.



Differentiated Instructional Strategies: One Size Doesn't Fit All, 2nd Edition (2007), by Gayle H. Gregory and Carolyn Chapman, provided a fitting starting point for our study. This book takes the reader through the rationale for differentiating instruction and features many examples of classroom practices. The Committee reached the conclusion that differentiated instruction does support the vision of OAME by providing a variety of entry points for students, as well as many options for demonstrating learning. At the same time, we felt that the main challenge for teachers interested in implementing differentiation lies in the lack of resources that specifically address differentiated assessment and evaluation.





The second book in our study was *How to Differentiate Instruction in Mixed-Ability Classrooms, 2nd Edition* (2001), by Carol Ann Tomlinson. This book briefly reviews the principles of differentiated instruction before outlining—in much detail—suggestions for lesson planning according to what is being differentiated (readiness, interest, learning profile, content, process, or product). I was particularly interested in Tomlinson's treatment of scaffolding—a term that I have heard frequently since I began teaching eight years ago, but have never quite been able to grasp.

The chapters pertaining to the role of the teacher and the learning environment in a differentiated classroom are also very informative. One feature of this book that the Committee members particularly liked was the extensive use of graphics to augment written descriptions. However, we found that once again, assessment and evaluation received insufficient attention.

The final book in the Equity Committee's book study was *Differentiated Assessment for Middle and High School Classrooms* (2008) by Deborah Blaz. Like the other two books that we studied, this book begins by providing a rationale for differentiating instruction in the classroom. The organization of this book makes it easy to use and provides many entry points for the reader, regardless of how much experience the reader has had with differentiated instruction. A short section on pre-assessment precedes a 24-page chapter on formative assessment. As Blaz points out, the typical focus by teachers on summative assessment instead of pre-assessment and formative assessment seems counterproductive, given that assessment should have an impact on learning. Blaz emphasizes the importance of formatively assessing student work while there is still time to adapt instruction, and stresses that formative assessment should appear in a wide variety of formats. The part I seem to have been missing, if I analyze my own use of these assessment strategies, is the need for follow-up by both student and teacher once the task is complete and the student's work has been assessed. I tend to rely (rather naïvely) on the belief that the student will

take the time to read, absorb, and respond to my carefully crafted feedback. I now see that follow-up is essential and that it must be both formal and purposeful.

Over one-third of this book focuses on summative assessment strategies. One of the book's real strengths is its breadth and depth of assessment types and additional resources in the form of Internet links. Blaz also makes an excellent case throughout the book for the use of exemplars as a regular component of classroom practice. One idea that was new to me was that students should be taught how to develop evaluation instruments and that they should be encouraged to create them for summative assessments. Blaz's rationale is that these instruments "help students think about the skills they already have, skills they need to demonstrate, and what skills they may still need to acquire to complete a product and earn an A."

Blaz stresses the need for variety in summative assessment tools and asserts that students should be assessed with the same types of tools that were used to teach the material. This is not a profound idea, but it is one that I had never stopped to consider until now. How many of us very creatively differentiate the content and process whenever possible throughout a unit, only to fall back on a final written instrument to evaluate student learning?

The summary at the end of nearly 80 pages devoted to summative assessment states that while any good summative assessment enables students to show what they know about a subject, a good differentiated summative assessment allows students to design and control the style of assessment according to their own interests, preferred performance style, and comfort level. Furthermore, it provides students with opportunities for self-evaluation throughout the assessment process and allows them to show a degree of creativity.

Another real strength of this book is the sheer number and variety of ideas for engaging students of all ability levels, backgrounds, and interests. Blaz also includes a host of checklists and rubrics to supplement many of the suggestions in the book. The chapter on the use of technology in assessment will appeal to the more technologically savvy reader, while introducing new ideas to the reader who may be less familiar with blogs, chats, telementoring, webquests, e-portfolios, and online publishing. The final chapter on implementing differentiated instruction reiterates the advice of Gayle Gregory and Carol Ann Tomlinson: Begin slowly and do not try to do everything suggested in the book!

When the Equity committee gathered to discuss *Differentiated Assessment for Middle and High School Classrooms,* we were unanimous in our selection of this book as the most practical of the three books in our study. Its range of ideas, resources, checklists, and rubrics, and its clear, unambiguous language, make it an essential resource for teachers in a differentiated classroom.

What are the next steps for the Committee? We continue to see a need for more resources designed to help teachers create grade books that reflect differentiated assessment. At our next meeting, we will discuss, in greater depth, a suggestion to set up a subcommittee to develop sample differentiated assessments and/or a sample differentiated grade book for our members. ▲

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▲ Math: The Cereal Killer

Mike McCabe, Ph.D.
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Mike McCabe teaches Mathematics Education and Health and Physical Education in the Faculty of Education at Nipissing University's Brantford campus. In addition, he teaches in the Aboriginal Teacher Certification Program. His research includes developing programs and strategies to include parents in formal education.

The other morning, my wife was lying in bed, trying so hard to remember the days when we could stay up late, sleep in late, and do very little else in between. Now, with three young children, those days are only faint memories. So, I thought I would do something very special for her—I would serve her breakfast in bed!

My wife enjoys bran and raisin cereal for breakfast, but she especially likes the kind with the most raisins in it. So, off to the kitchen I went to prepare the surprise. Upon opening the cereal cupboard door, I was met with as complex a problem as I wished to encounter on this fine weekend morning—there were four different boxes of bran and raisin cereal from which I could choose:

- Master Choice *40% Raisin Bran Flakes*
- Kellogg's *Two Scoops Raisin Bran*
- Compliments *Maximum Raisin Bran Flakes*
- President's Choice *Extra Raisin Raisin Bran*

Now, in my role as a Mathematics Education professor, I have trained myself to recognize mathematics in everyday life, and it is my job to transfer this skill to the young aspiring teachers I instruct each year. In fact, the need to relate mathematics to everyday events is mentioned no fewer than 15 times in the Ontario Elementary Mathematics Curriculum **www.edu.gov.on.ca/eng/curriculum/elementary/math.html**. In particular, in the *Importance of Mathematics* description at the beginning of the Mathematics Curriculum (p. 3), it states:

> *Through mathematical activities that are practical and relevant to their lives, students develop mathematical understanding, problem-solving skills, and related technological skills that they can apply in their daily lives and, eventually, in the workplace.*
>
> *Mathematics is a powerful learning tool. As students identify relationships between mathematical concepts and everyday situations and make connections between mathematics and other subjects, they develop the ability to use mathematics to extend and apply their knowledge in other curriculum areas, including science, music, and language.*

Some say I take my job too seriously. I will let you decide. What I had in front of me now (the four cereal boxes) was going to take all the resources I had available to me. Let me attempt to describe the front of each cereal box and the questions I conjured up, keeping in mind the ultimate goal of providing my wife with the cereal that contained the most raisins. Necessary to fully understanding the problem is that each box claimed to have 775 g of product inside[1] and that three of the four boxes had an asterisk (*) that would require further investigation. Each box also showed a larger-than-reality sample of contents, along with a disclaimer that the "photo is enlarged to show texture." To help relate all of this to the math curriculum, I have included a number of direct references to the specific expectations. These are indicated through the superscripts within, which are matched to Appendix A.

Master Choice "*40% Raisin Bran Flakes*"

This product claimed to contain 40% raisins[2] (followed by an *), and the company was confident enough to include this claim in the name of the cereal. The box also claimed that the cereal had "crispy flakes of whole grain wheat bran and plump, juicy Thompson raisins that provide a source of dietary fibre and are a delicious source of nine essential nutrients." I immediately wanted to know about the asterisk (*). Did it mean that for every ten "things" in the box, four of them were raisins? Upon further investigation, I found the reference* that claimed "40% raisins by weight." A quick run for the calculator revealed that this box should contain 310 g of raisins[3]. I wondered how this would stack up with the remaining three boxes. I also wondered how many essential nutrients there are, and what constitutes a product having enough of something to be considered a "source of essential



nutrient." To solve this problem, I had to resort to my old high school biology textbooks that I had stored in boxes in the basement. According to Hickman, Roberts, and Hickman (1982, p.188), "nearly 30 organic compounds (amino acids and vitamins) and 21 elements have been established as essential." I wondered what "nearly" meant. Adding the organic compounds and elements together, I determined that there are "nearly" 51 essential nutrients.

Kellogg's "*Two Scoops Raisin Bran*"



Now, this was the product with which I was most familiar. My mind flashed back to the too-familiar television commercial featuring a lumberjack with the accompanying music and lyrics: "Sturdy Danny McGee was up his 59th tree, and he said, 'I work as fast as I can for those two scoops of raisins in the package of Kellogg's Raisin Bran.'" The box also claimed that the contents were "very high in fibre and contained bigger, juicier raisins."

Two scoops[4] of raisins is a lot of raisins by anyone's calculations, right? If you watch the commercials closely, the raisins pour out of the scoops and into the box for an extraordinarily long time. But just how many raisins were in a scoop, and how big were those scoops? Was each scoop the same size? I had to know. As to the claim that the cereal contained bigger, juicier raisins, I had many questions. By the time we leave Kindergarten, we are all familiar with the use of the comparative words *big, bigger, biggest*[5] as we order objects from smallest to biggest[6]. But, in this instance, to what were we comparing these bigger, juicier raisins? Was it to the plump, juicy Thompson raisins in the Master Choice cereal? Was it to the previously packaged box of Kellogg's? Was it to last year's batch of raisins? The remainder of the box provided no help in solving this mystery. Equally puzzling to me was the claim that the cereal was "very high in fibre." Again, I wondered, what made something "very high" in fibre, compared to something "high" or "low" or "very low" in fibre? Was there a quantifiable measure that dictated and/or justified the adjectives used?

Compliments "*Maximum Raisin Bran Flakes*"

When I got to this cereal box, I figured I had finally solved the problem of finding the cereal with the most raisins. "Maximum," I was sure, meant "the most"! I learned that way back before my formal schooling experience[7]. Of course, way back then, when we had competitions with our peers, we used words like "infinity," only to be bested by the "infinity plus 1" response. But given the "Maximum Raisin" name, was I wrong to think that I was looking at a box full of raisins? Below the name of the cereal was "contains 40% raisins" with an * after it. The box also claimed that the cereal was a source of 7 vitamins and minerals. My well-honed research skills eventually found the * that explained it was "40% raisins by weight." I then came to the logical conclusion that there must be some rule or law that dictates that when producing raisin and bran cereal, you cannot put more than 40% raisins by weight in the box. Who makes these rules, and why? Are vitamins and minerals classified as essential nutrients? And again, how many vitamins and minerals are there in total? Does this mean that Compliments doesn't have any other essential nutrients? Back to the old high school biology textbook!

President's Choice *"Extra Raisin" Raisin Bran*

The most peculiar aspect of this product name was the singular reference to an extra raisin. (Note that it is called "Extra Raisin," not "Extra *Raisins*.") Again, I had nothing to which to compare this. Was it a reference to the previous box they had packaged? Was it a reference to the other products in my cupboard, and if so, which one(s)? This left me perplexed. This brand also claimed to be a source of 10 essential nutrients, whereas the other bran and raisin cereals claimed to be sources of only 9 essential nutrients. All the same questions ran through my mind (see above), with one addition. *Could it possibly be that the extra essential nutrient was contained within the extra raisin?*

I was now more confused than ever! Simple to see was the need to count[8] and weigh[9] the raisins within each of the boxes. I set to it. I separated the bran from the raisins and the raisins from the bran for each of the cereal boxes. I then counted the raisins, weighed them, and determined a percent by mass of raisins[10] for each of the 775 g boxes. The following chart is the result[11]:

Table 1. *A comparison, by brand, of number of raisins, mass of raisins, and percent mass of raisins*

	Master Choice *40% Raisin Bran Flakes*	Kellogg's *Two Scoops Raisin Bran*	Compliments *Maximum Raisin Flakes*	President's Choice *"Extra Raisin" Raisin Bran*
Number of raisins[8]	480	209	547	397
Mass of raisins[9]	299g	198g	312g	245g
Percent mass of raisins[10]	38.6%	25.5%	40.3%	31.6%



Then, having tabulated all the necessary results, I wondered how each product's claims compared to my calculations. I also wanted to know why there was such a disparity among the boxes with respect to the number of raisins in each. It brought to mind issues related to consumerism, pricing, advertising, and the validity of my sampling. These matters, however, are best left for another day.

My concentration was suddenly broken as my lovely wife came downstairs looking rested and refreshed. She glanced at the clock, and, seeing that it was nearly noon, proclaimed her thanks to me for letting her sleep in. She then asked, "What's for lunch?"

Life used to be so much easier!

Appendix A

List of Specific Expectations from the Ontario Mathematics Curriculum

Note: *By no means is this a comprehensive list. It is meant to demonstrate the large number of specific expectations from a variety of grade levels that could potentially be targeted in lessons.*

1 **Grade 3: Measurement**
estimate, measure, and record the mass of objects (e.g., can of apple juice, bag of oranges, bag of sand), using the standard unit of the kilogram or parts of a kilogram (e.g., half, quarter)

Grade 4: Measurement
estimate, measure, and record the mass of objects (e.g., apple, baseball, book), using the standard units of the kilogram and the gram

2 **Grade 6: Number Sense and Numeration**
estimate quantities, using benchmarks of 10%, 25%, 50%, 75%, and 100% (e.g., the container is about 75% full; approximately 50% of our students walk to school)

3 **Grade 7: Number Sense and Numeration**
solve problems that involve determining whole number percents, using a variety of tools (e.g., base ten materials, paper and pencil, calculators)

Grade 8: Number Sense and Numeration
solve problems involving percents expressed to one decimal place (e.g., 12.5%)

4 **Grade 1: Measurement**
demonstrate an understanding of the use of non-standard units of the same size (e.g., straws, index cards) for measuring

5 **Grade 1: Measurement**
compare two or three objects, using measurable attributes (e.g., length, height, width, area, temperature, mass, capacity), and describe the objects, using relative terms (e.g., taller, heavier, faster, bigger, warmer; "If I put an eraser, a pencil, and a metre stick beside each other, I can see that the eraser is shortest and the metre stick is longest.")

6 **Kindergarten**
compare and order two or more objects according to an appropriate measure (e.g., length, mass, area, temperature, capacity), and use measurement terms (e.g., hot/cold for temperature, small/medium/large for capacity, longer/shorter or thicker/thinner for length)

Grade 2: Measurement
compare and order a collection of objects by mass and/or capacity, using non-standard units

7 **Mathematical Process Expectation**
communicate mathematical thinking orally, visually, and in writing, using everyday language, a developing mathematical vocabulary, and a variety of representations

8 **Grade 1: Number Sense and Numeration**
count forward by 1's, 2's, 5's, and 10's to 100, using a variety of tools and strategies (e.g., move with steps; skip count on a number line; place counters on a hundreds chart; connect cubes to show equal groups; count groups of pennies, nickels, or dimes)

Grade 2: Number Sense and Numeration
count forward by 1's, 2's, 5's, 10's, and 25's to 200, using number lines and hundreds charts, starting from multiples of 1, 2, 5, and 10 (e.g., count by 5's from 15; count by 25's from 125)

9 **Grade 2: Measurement**
compare and order a collection of objects by mass and/or capacity, using non-standard units

Grade 4: Measurement
estimate, measure, and record the mass of objects (e.g., apple, baseball, book), using the standard units of the kilogram and the gram

10 **Grade 7: Number Sense and Numeration**
solve problems that involve determining whole number percents, using a variety of tools (e.g., base ten materials, paper and pencil, calculators)

11 **Grade 5: Data Management and Probability**
read, interpret, and draw conclusions from primary data (e.g., survey results, measurements, observations) and from secondary data (e.g.,

precipitation or temperature data in the newspaper, data from the Internet about heights of buildings and other structures), presented in charts, tables, and graphs (including broken-line graphs)

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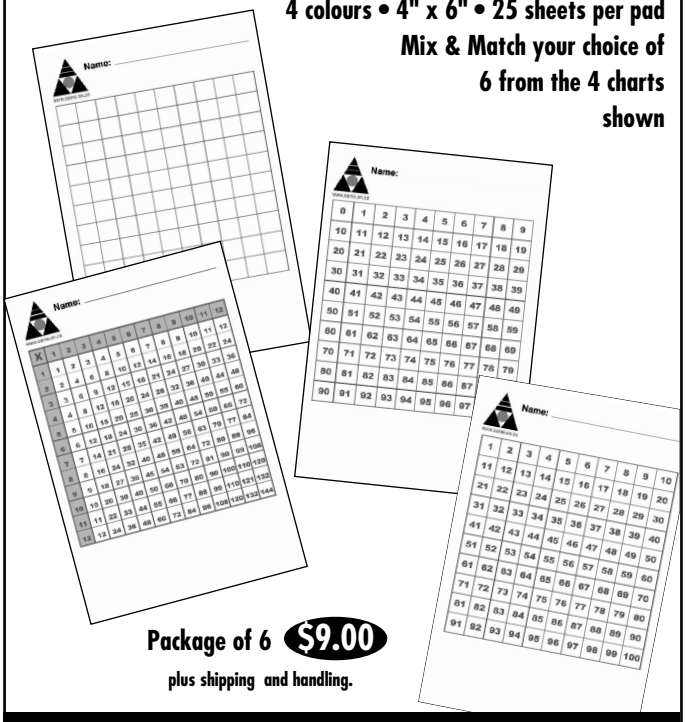
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President's Choice *"Extra Raisin" Raisin Bran* Cereal Box. Toronto, ON: Loblaws Inc. ▲

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▲ Thinking Outside The Rectangular Prism: Fostering Problem-Based Mathematics Learning

DAN JARVIS



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Problem-Based Learning

"How would you describe your own mathematics education history? What was math class usually like for those 15+ years of your life?" It is this type of question that I like to pose to new teacher candidates each fall as they begin their Bachelor of Education program. For many of them, myself included, similar images, routines, and teacher/student behaviours are recalled, whether success was experienced in school mathematics or not. For example, a more traditional approach to mathematics learning often featured the teaching of a new skill (or skill set), followed by isolated practice questions, and then several application problems. But life's not quite like that, is it? Do we not face complex situations from dawn to dusk that involve people, places, and problematic things? And within these chaotic contexts, do we not continually attempt to look for patterns, draw upon prior knowledge and intuition, make suggestions, try out ideas, negotiate with others, learn from our mistakes, and document our progress? Sometimes, we even solve the problem! However, it is arguably the messy process that is the most meaningful in terms of individual growth, social learning, and the ability to tackle tomorrow's problem with equal—or even increased—determination.

Problem-Based Learning (PBL) is certainly not a new concept, but it is receiving an increasing amount of attention in reform-oriented mathematics resources and from reform-oriented mathematics organizations. For example, the *Ontario Curriculum: Mathematics, Revised* (Ontario Ministry of Education, 2005a, 2005b, 2007)

advocates Problem Solving as one of its seven core mathematical processes[1], and the National Council of Teachers of Mathematics (NCTM) strongly argues for a problem-solving focus in its *Principles and Standards for School Mathematics* document:

> *Solving problems is not only a goal of learning mathematics but also a major means of doing so. Problem solving is an integral part of all mathematics learning, and so it should not be an isolated part of the mathematics program. Problem solving in mathematics should involve all the five content areas... Good problems will integrate multiple topics and will involve significant mathematics. (2000, p. 52)*

Many math teachers are familiar with the work of the late John van de Walle, particularly in terms of his helpful three-part lesson (i.e., *before* [getting ready], *during* [students at work], and after [class discussion]) (Van de Walle & Folk, 2008, p. 42). Van de Walle describes a problem-based approach:

> *...students solve problems, not to apply mathematics but to learn new mathematics. When students engage in well-chosen problem-based tasks and focus on the solution methods, what results is new understanding of the mathematics embedded in the task. When students are actively looking for relationships, analyzing patterns, finding out which methods work and which don't, justifying results, or evaluating and challenging the thoughts of others, they are necessarily and optimally engaging in reflective thought about the ideas involved... It is a process that requires faith in children—a belief that all children can create meaningful ideas about mathematics. (pp. 37–38)*

In describing her "10 big math ideas," author Marilyn Burns (2004) notes that "confusion is part of the process" and that we, as teachers, should be continually attempting to "encourage different ways of thinking" (p. 19). In discussing learning contexts that are highly engaging and satisfying for students, Seymour Papert introduced the notion of "hard fun," a term that he adopted after talking with a young student who had been using his Logo computer software program. Papert further notes:

> *I have no doubt that this kid called the work fun because it was hard rather than in spite of being hard. Once I was alerted to the concept of 'hard fun' I began listening for it and heard it over and over. It is expressed in many different ways, all of which all boil down to the conclusion that everyone likes hard, challenging things to do. But they have to be the right things matched to the individual and to the culture of the times. (n.d., paragraph 2)*

Canadian author Marian Small (2008), yet another strong advocate for problem-based mathematics learning, notes that "some of the ways teaching through problem solving differs from a traditional approach include: an increased level of mathematical dialogue between students; the teacher's role as guide or coach more than as a presenter; and, the teacher's more judicious use of intervention" (p. 38).

As a teacher who has worked with elementary and secondary school students, and who now has the wonderful opportunity to work with prospective teachers, I have collected many mental images of different forms of PBL through the observation of colleagues, through practice teaching supervision, and through my own experimentation with a more problem-based approach to learning. What follows, therefore, is a distilled version of all of that information—those multiple perspectives—in terms of practical implications of what this type of teaching might include. With grateful acknowledgement of Van de Walle's "three-part lesson" and of the "MATCH Template" that was further developed by the authors of the Targeted Implementation and Planning Supports (TIPS) resource (Consortium of Ontario School Boards, 2005), I intend to reframe the PBL process using four headings—*Explain, Explore, Express,* and *Extend*—and to show how the seven Ontario mathematical processes[2] are naturally incorporated within this teaching method. I was tempted to use the pun-laced title, "Problem-Based Learning with E's," but those educators who have been brave enough to attempt even a small move toward PBL know that there is nothing particularly simple or "easy" about this type of pedagogy. On the contrary, it's hard work—but it's fun.

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[1] Within the Ontario Curriculum: Mathematics, Revised (2005–07), the following seven core mathematical processes are highlighted: problem solving; reasoning and proving; reflecting; selecting tools and computational strategies; connecting;representing; and communicating. All seven of these can be practised regularly in a classroom where PBL is being used.

[2] I would like to thank both (anonymous) reviewers of this article, and particularly the one who suggested that I more thoroughly elaborate on the mathematical processes throughout this paper.

Explain the Problem

The teacher should begin the class by asking one or two questions that pertain to "real-life" situations and that also relate to the new problem of the day (e.g., for young learners, "How many of you have buttons on your clothing today? Which colours? etc., prior to a graphing exercise; or for older learners, "How many of you have travelled to Toronto? Approximately how long did that take?" etc., leading up to a problem involving travel budgets). These introductory questions (which may also tie into previous learning in the class) serve to engage the group and provide a bridge to the problem (e.g., "Similarly, today's problem will involve…"). By asking such questions, the teacher is also promoting the mathematical process of ***connecting***. The teacher should then present the problem in at least two different ways so that all students will have a chance to absorb the information. For example, the problem should be read aloud to the class, but should also be presented in writing (e.g., in a student handout, on flip-chart paper, or perhaps using a *PowerPoint* slideshow or other presentation software). For the English Language Learner or the ESL or LD student, it would also be appropriate to provide a concrete or pictorial explanation of the problem, but perhaps individually, as it is preferable that most students model the problem on their own.

At this point, it is very important that the teacher now literally stop and ask students to rephrase the problem in their own words, without reading it from the screen or a handout; e.g., "What are we being asked to do in this problem?" and, "What are some important things that we need to consider?" This step accomplishes several objectives. First, it allows the teacher to better understand what it is that the average student has understood, or not understood, about the problem. Second, having the problem restated by a peer in "student-ese" often helps other students "clue in" to the problem. Third, having students mentally summarize the stated problem helps them to develop the mathematical process of ***reflecting***. Once the important information has been publicly volunteered and/or solicited, the teacher asks the class if there are any other questions, or if further clarification is needed with respect to the problem. If this crucial step is skipped, the usual result is that the teacher will have to spend 10–20 valuable minutes answering the same clarification question(s) with all groups in the room.

Explore the Problem

Students are seated in pairs, triads, or small groups with no more than six to a table (as large numbers preclude meaningful dialogue and make the distribution of intellectual work more difficult). At the tables (or grouped desks), there should be manipulatives; possibly technology (e.g., calculators, depending on the problem); and a large sheet of blank flip-chart paper (or grid paper) with markers. Access to manipulatives can be dealt with in several ways. Some teachers have them organized in clearly labelled bins at the periphery of the classroom (on shelves or in cupboards). Others place the desired manipulative(s) on each group's table in advance of the lesson. In my own workshops with teacher candidates, I have moved toward a slightly different approach—that of providing many different manipulatives from which the teacher candidates themselves can choose. These "Thinking Kits" have gone through several stages of development. I initially used various plastic bins held together with duct tape (The Red Green Special—see *Figure 1*), with each bin containing a particular type of manipulative (e.g., linking cubes, two-sided counters, pattern blocks). I then moved to a set of much larger plastic bins (see *Figure 2*) containing manipulatives separated into individual zip-locked bags. (The double-zip design is best, as it is much easier to open and close and seems to last longer.)



Figure 1. First version of the manipulative "Thinking Kits"



Figure 2. Second version of the manipulative "Thinking Kits"

One may argue, and rightfully so, that using kits filled with manipulatives is not a new idea in mathematics teaching. That being said, the main difference here is that by making these kits always available over the course of the year, and by not prescribing which manipulatives should be used for any given problem, teacher candidates become familiar with the different manipulatives (see *Figure 3*) and develop a sense of what to use when, and why, without being told. In terms of the mathematical processes involved, by following this method, the teacher candidates are ***representing*** (modelling) the problems and ***selecting tools and strategies*** to solve the problems. This method also fosters richer discussion, as the teacher candidates will often use a number of approaches and/or materials to tackle the given problem. In the third version of the kits, I removed some manipulatives such as clocks, Tangrams, and Pentominoes—items that are not as useful for solving a variety of problems, but that can be brought out separately during the year to teach particular topics, or for specific types of mathematical explorations.



Figure 3. Common manipulatives found within the kits

Our own *Ontario Curriculum: Mathematics* documents (Ontario Ministry of Education, 2005a, 2005b) note the following regarding the selection and use of manipulatives or concrete learning tools:

> *Students should be encouraged to select and use concrete learning tools to make models of mathematical ideas. Students need to understand that making their own models is a powerful means of building understanding and explaining their thinking to others. Using manipulatives to construct representations helps students to see patterns and relationships; make connections between the concrete and the abstract; test, revise, and confirm their reasoning; remember how they solved a problem; and, communicate their reasoning to others. (pp. 14–15)*

Although the types of manipulatives found within a kit may vary, the same approach to PBL can and should be taken, at least occasionally, with secondary school students as well. For example, my calculus students were just as enthusiastic about using cylinders, water, and timers when studying rates of change as my own preschool children were in using linking cubes to study patterns.

During the *explore* stage, teachers are encouraged to first perform a quick rotation through the room, stopping at each group only long enough to ensure that students are on task, and to provide clarification where needed. Following this first circuit, the teacher is now free to make several slower rotations throughout the room for the remainder of the period, during which time he or she is able to collect valuable assessment information. The ability to ask good questions is developed during this time, as are the skills of listening and scaffolding. Anecdotal information is often collected from one or two groups during a problem-based lesson, with the teacher planning to eventually assess all students over subsequent lessons. This is also an opportune time to encourage and assess students as they demonstrate the mathematical processes[3].

Express the Problem/Solution

The *expression* (or consolidation) stage is, unfortunately, the one that is most often poorly done or entirely ignored, yet it is arguably the most important part of the PBL approach. There are many ways to orchestrate this sharing of student work. The method that I have witnessed and like the most—and have hence adopted—is as follows: the teacher first asks for one

[3] *For an excellent set of questions that encourages development of the mathematical processes, the reader may wish to consult the Targeted Implementation and Planning Supports for Revised Mathematics (TIPS4RM)* Process Package*, available online at* ***www.edu.gov.on.ca/eng/studentsuccess/lms/files/tips4rm/TIPS4RMProcesses.pdf.***

group (or pair) representative to stand and express the group's solution attempt. This solution is then posted at the bottom of the left-hand side of the board. The teacher then asks if any other groups have solved the problem in a similar way. If so, representatives from those groups come forward and pin or tape their solutions directly above the first group's sheet. Now the teacher asks for another way to approach the problem, followed by a student presentation. These students pin their solutions to the wall in a second column, adding similar group strategies to this column vertically. When complete, all group solutions appear on the front board in a sort of visual histogram format (i.e., a vertical bar graph of solution types). Note that students can choose to use actual manipulatives and/or technology to present their solutions to the larger group; often the group (or partner) recorder will use an illustration to show how the group or pair used the manipulatives, making it somewhat easier to present this thinking to the class. In this situation, students are ***communicating*** ideas that make sense to them, thereby demonstrating another mathematical process.

Finally, students are asked to examine the various solutions in order to make comparisons, point out overlapping parts of solutions (perhaps moving solutions to other columns as a result of a specific rationale), discuss preferred approaches, and so on.[4] This represents a form of higher-order ***reasoning and proving***—our final mathematical process—which, if practised as a regular part of problem-based teaching/learning, will encourage students to routinely look for multiple-solution strategies en route to a final and justifiable answer. Note carefully, that if all solution strategies are identical and are thus visually displayed in one single, long column, this is usually a clear sign that the problem selected by the instructor is much less "rich" than one that would allow for two or more approaches. (The best problems are collected over time, based on feedback and reflection.) Finally, the verbal expression of solutions is paramount—students need to know that you value their work and ideas, as demonstrated by your willingness to listen.

[4] For a description of a similar, yet much more elaborate, version of this type of board-based consolidation activity, the reader may wish to consult the work of Takahashi (Japanese "Bansho") and Kubota-Zarivnij (Ontario "Bansho").

Extend the Problem

In this final stage, students can work on a similar problem for their home assignment and/or can even be given the opportunity to create or pose their own related problems, to be shared with their peers in subsequent lessons. Although practising basic skills is still an important part of any mathematics program, home assignments/practice should also feature—on occasion at least—the tackling of similar "rich" problems so that students may further build upon the new knowledge and understanding that they have acquired during the PBL process. Double exposure to a problem (i.e., both inside and outside of school) will help reinforce concepts and will raise an awareness of mathematics in the student's everyday world. Once again, the mathematical process of ***connecting*** is being reinforced at this stage. Often, problems will require more than one lesson for students to adequately explore the content. In this case, the problem-solving activity can be extended over two or more days, allowing students the time to seek out further information, gather input from other people, and revisit the problem in different ways.

Closing Thoughts

Bluntly put, problem-based learning can be very uncomfortable at first, both for the teacher and for the students. If the former is used to "delivering" lesson content from well-polished, teacher-centred lesson plans, and prefers a quiet, non-interactive classroom, this approach to learning can be quite unnerving. Further, if students have not had adequate experience in productive, co-operative group-work contexts, a gradual introduction of such tasks will be required, moving from short, specific problems to much more involved tasks and/or problems later on.

Helping students to think outside the rectangular prism (i.e., the *Thinking Kit*) as they solve rich problems and share their results with peers represents a worthwhile, tangible, and reform-oriented goal. By explaining, exploring, expressing, and extending (see *Figure 4*) carefully selected problems, teachers can begin to compile a fantastic collection of resources that will engage students and foster their critical-thinking skills. And it is these very skills, forged through the *hard fun* of Problem-Based Learning experiences, that may turn out to be the most useful and beneficial for our students throughout their future lives.

EXPLAIN

- ☐ Q_T : Questions posed by teacher regarding real-life interests and/or prior knowledge
- ☐ P_T : Teacher presents the problem in both visual and verbal ways
- ☐ P_S : Problem is rephrased by students in their own words, without reading it
- ☐ Q_S : Questions from students regarding clarifications or possible misunderstandings

EXPLORE

- ☐ R_F: Fast rotation to make sure everyone is on-task
- ☐ R_S: Slow, multiple rotations to assist, assess, and ask good questions

EXPRESS

- ☐ Communicate: Student representatives present their group's solution strategy
- ☐ Compare: Students organize solutions into a visual histogram and compare strategies

EXTEND

- ☐ Continued thinking about the problem that evening, if extended over two or more days
- ☐ Similar practice questions/problems assigned to (or created by) students that evening/week

Thinking Kits for elementary/middle school problem-based mathematics learning might include the following items: linking cubes (small and large sizes), two-sided counters with 5- and 10- frames, counting bugs/objects, pattern blocks, square tiles, fraction pie pieces, number cubes, tape measures, Canadian currency, sorting hoops, algebra tiles, spinners, and calculators (for certain activities).

Figure 4. Checklist of the four E's in the Problem-Based Learning approach

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▲ Mathematics Literacy in the Media

WAYNE ERDMAN



Wayne is the curriculum leader of Mathematics and Computer Studies at Eastern Commerce C.I., president of the TEAMS chapter of OAME, and senior mathematics author for McGraw-Hill Ryerson. He believes that numeracy and literacy are strongly linked, and that communication should be a focus in the mathematics classroom.

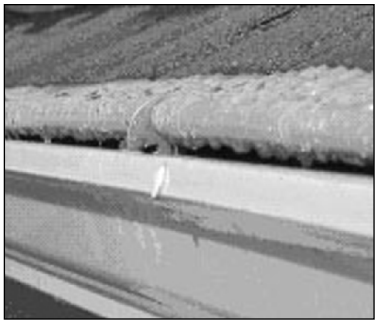
While drinking my morning coffee and reading my local newspaper, it struck me how poorly members of the media—and society in general—use mathematical terminology. I'm not talking about misinterpreting mathematics, or making mathematical errors. All too often, terminology is used to convey a mathematical message, either where none exists, or in a way that is improperly stated. So, I decided to list some of the ways in which mathematics terminology is misused by the media. This is not a rebuttal of the use of math to prove a point, such as the existence of global warming, or whether there is life on other planets; it is more a rant about mathematical illiteracy in the media.

So, here is my list, in descending order, of math terminology that is frequently misused by members of the media:

- **"Giving 110%"** – For example, during the 2008 Summer Olympics, a TV announcer stated that swimmer Michael Phelps "gave 110%" during the 100 m race. Although 110% is achievable (e.g., through a ratio of two quantities), I defy anyone to be able to give any more than 100% of his or her abilities! So "giving 110%" has simply become an expression for doing one's best.
- **"Amount of"** instead of **"number of"** – This results from the failure to differentiate between continuous and discrete variables. How often have we heard the phrase, "The amount of people…"? The term "amount of" should be used for measurements, such as "the amount of water," while "number of" should be used for counting, such as "the number of cookies."
- **"Less than"** instead of **"fewer than"** – This may also

result from misunderstanding continuous versus discrete variables, and can be linked to the use of the < and > symbols used in math classes. When x is a real number, x < 5 is read as "less than," but if x is a whole number, such as when we are counting the number of items, it should be read as "fewer than." (E.g., "Fewer than sixty people attended.")

- **"Odds"** – "The odds of rolling a pair of sixes are 1 in 36." We hear this all too often in the media when odds are confused with probability. It should be stated as follows: "The odds *against* rolling a pair of sixes are 35 to 1" or "The odds *in favour of* rolling a pair of sixes are 1 to 35." Alternatively, the word "odds" can be replaced with "chances" or "probability."
- **"Fraction of"** – Although the dictionary defines a *fraction* as "a numerical quantity that is a quotient of two numbers," members of the media often use it to mean "significantly less than." Consider the following advertisement:

> ***The Gutter Shield*** *provides proven relief from falling leaves and clogged gutters* ***at a fraction of the cost*** *of competitive products. Guaranteed lowest price every day!*
>
> 

- **"Percent increase"** instead of **"percentage-point increase."** When a political party increases its popularity from 40% to 45% of the voters, we often read that the party enjoyed "a 5% increase in popularity." In reality, this should be stated as "a 12.5% percent increase," since 5 ÷ 40 x 100 = 12.5%. We could, however, state this as "a 5 *percentage-point* increase."
- **"Minus"** instead of **"negative"** (or **"plus"** instead of **"positive"**) – "The temperature reached a low of minus 5 degrees yesterday." Since "minus" is an operation, "minus 5 degrees" makes no mathematical sense; this should be stated as "negative 5 degrees." Further examples of this type of slang in math include "You *times* it by five" instead of "you *multiply* it by five."
- **"Exponential growth"** – "The number of *Tim Hortons* coffee outlets has grown *exponentially* over the past 5 years." It seems that any growth in business or demographics that is non-linear is termed "exponential," even when there is no statistical evidence of it being so!
- **"A 360-degree evaluation"** – This term is used by the business community and refers to the practice of letting staff members evaluate the performance of their supervisors. Since this represents a half-turn from the standard method of supervisor–employee evaluation, shouldn't it be called a 180-degree evaluation?
- **Misplaced decimals in prices** – Retailers regularly make this mistake (e.g., 0.95 cents, rather than 95 cents, or $0.95). According to the following ad, face cloths can be purchased for less than ½ cent each!



- **Misstated sports statistics** (e.g., winning percentage, games above .500) – A team's winning percentage is a misnomer because it is commonly written as a number to three decimal places (e.g., .613), rather than as a percent (61.3%), and so "winning average" might be a more appropriate term. Another example in sports is that a 32-win and 28-loss record is stated as 4 games above .500 (4 games above 50%), whereas, had the team won just 2 fewer games (i.e., a 30–30 record), it would have a .500 record. Thus a 32-28 record should be 2 games above .500, or, more simply, 4 more wins than losses.

- **"...times less than"** – I have yet to figure out what "5 times less than" really means. Are we subtracting and multiplying, or are we dividing by 5? Even Statistics Canada gets into the act in *The Daily*, July 12, 2002, with the sentence, "Although per capita wine sales in Canada resemble those of Norway, Russia, and the United States, they are five to six times less than those in France, Italy, or Switzerland."

And, finally, the most egregious misuse of mathematical terminology:

Use of the word "random" – When commenting on crime, both the police and the media use "random" to mean non-planned (e.g., a random shooting). Unfortunately, so do teenagers, when they say, "We're going to some random movie tonight." Properly used, random means "without direction or rule," or "equally likely," as it is used in statistics, when a sample of a population is randomly generated. Fortunately, MP3 players get it right when selection of the "random" button produces a truly random selection of tunes.

Why did I make this list? I suppose it's a good starting point for encouraging precise communication and media literacy. As educators, we need to help our students develop their critical-thinking skills. Although critical thinking is meant to focus on students' analytical skills, it also includes mathematical literacy and communication.

How can we get our students to become active participants in this process? I have suggested a few follow-up activities:

a) Have your students make a list of mathematical words or phrases that come up in everyday conversation. Discuss whether these words or phrases represent mathematical errors, or whether the mathematical usage was derived from other uses in the English language.

b) Make a poster about mathematical mistakes in the media. You might begin with a discussion about the use of statistics in the media. Have your students discuss the errors and state how the errors should be corrected.

c) Ask your students to suggest math words that have a common usage, such as "root" and "prime." Then have them provide both definitions, along with examples.

d) Have a regular "Bad Math in the News Day," where students identify a math error in a newspaper or magazine article and write a letter to the editor explaining the mistake.

Both literacy and numeracy are important in our society. Mathematical literacy includes the ability to communicate using mathematics, to reason with mathematics, to interpret data and graphs, and to solve practical problems. It is important that all forms of media, as our primary means of mass communication, contribute to the development of mathematical literacy. Encouraging members of the media to improve their own mathematical literacy, and helping our students to become more critical readers of mathematics in the media, are steps that will go a long way toward building a more mathematically literate society.

In the meantime, let's all check our own misuse of mathematical language at the door and encourage the proper use of language and vocabulary through classroom discussions and activities.

Suggested Reading

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▲

▲ Calculus and Vectors: The Connections

FRANCES SCHATZ
www.onestepatatime.net



Frances Schatz, retired mathematics tutor, former Abacus editor, and former NCTM representative, now does part-time marking and writing for self-direct secondary school mathematics courses at the St. Louis Adult Learning Centre in Kitchener. She just recently achieved professional member status with the Canadian Authors Association, is launching a career in writing children's literature, and enjoys spare time at her apple orchard farm. An active OAME member since 1981, her career as a mathematics educator spans 42 years.

During the first year of the course *Calculus and Vectors*, I had the distinct pleasure of assisting high school students who thrive on knowing more than what the curriculum specifies, or the classroom teacher could cover. During that time, many of my adult self-study students asked, "Why are vectors taught with calculus? What is the connection?" Although, as teachers of MCV4U, we have been working without an official textbook for this course, we have carefully searched the available resources in an effort to effectively present it.

The Ontario curriculum says that students will solve problems involving vectors, broaden their understanding of rates of change, and apply these concepts and skills to the modelling of real-world relationships. One *mathematical process* expectation is that students make connections among mathematical concepts and procedures. Although the curriculum does not specifically mention unit vectors, it is hard to discuss algebraic vectors without reference to the foundation vectors for the three axes.

The following is a part of Lesson 20 Summative and Review that I wrote for our self-study students of MCV4UA at St. Louis Adult Learning Centre, and I shared this unit with my keen private students.

Calculus and Vectors: The Connections

We have studied derivatives of real-valued functions in R^2 (two-space), and we have studied vectors in R^3 (three-space). How can we connect the derivatives of polynomials, trigonometric functions, and exponential and logarithmic functions to vectors? We've used these functions to describe the velocity and acceleration of objects in R^2; what happens in R^3?

When we shoot a projectile into the air, we usually want to know beforehand how far it will go (Will it reach the target?), how high it will rise (Will it clear the trees?), and when it will land. This information can be obtained from the direction and magnitude of the projectile's initial velocity vector, described in terms of the angle and speed at which the projectile is fired. The equations come from combining calculus and Newton's second law of motion in vector form. Ideal projectiles move along parabolas.

To describe the motion, we fire the projectile at time $t = 0$ from the origin of the xy-plane. Suppose the projectile moves in the first quadrant with an initial velocity vector of magnitude v_0 (velocity at $t = 0$) that makes an angle θ with the positive x-axis. See ***Figure 1***, which shows the x-axis as horizontal range R and the y-axis as the height above ground. There is also the pull of gravity, represented by $F_y=-mg$. At any time, $t \geq 0$, the projectile's position is given by a coordinate pair $(x(t), y(t))$. Recall the parametric equations of a line or plane in R^2 or R^3. We will also assume that these parametric functions have continuous derivatives with respect to t.

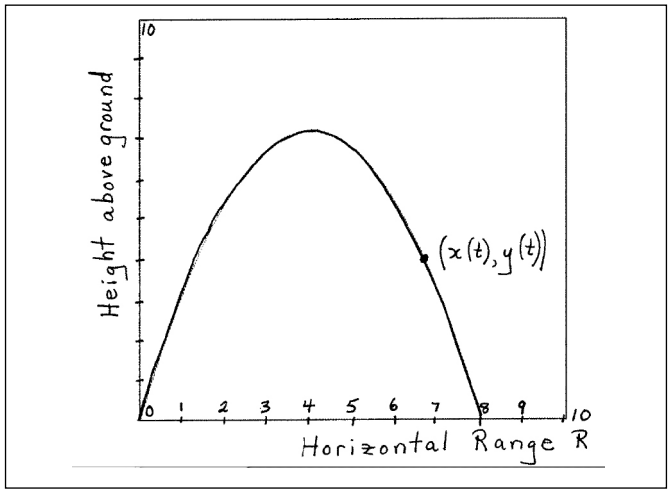


Figure 1.

Set up the initial conditions for the projectile's motion:

It starts at the origin, thus $x(0) = 0$ and $y(0) = 0$

$$v_x(0) = \frac{dx}{dt}\Big|_{t=0} = v_0\cos\theta$$

$$v_y(0) = \frac{dy}{dt}\Big|_{t=0} = v_0\sin\theta$$

We need to write $F_y = -mg$ (m is the projectile's mass and g is the acceleration due to gravity 9.8 m/s^2).

Recall that the derivative of $-\frac{1}{2}gt^2$ with respect to t is $-gt$.

We can now describe the position of the projectile t seconds after firing as $x = (v_0\cos\theta)t$, $y = (v_0\sin\theta)t - \frac{1}{2}gt^2$.

Example 1

A golf ball leaves the ground at a 30° angle, hit at an initial speed of 27 m/s.

a) Write the parametric equations that describe its position at any time, t, in seconds.

b) When does the golf ball reach its highest point?

c) How high does the golf ball rise?

d) When does the golf ball land?

e) How far does it travel horizontally?

Solution:

a) The position of the golf ball is described by

$$x = (27\cos 30^\circ)t = \frac{27\sqrt{3}}{2}t$$

$$y = (27\sin 30^\circ)t - \frac{1}{2}(9.8)t^2$$

$$= 13.5t - 4.9t^2$$

b) The golf ball will reach its highest point when its vertical velocity component is zero.

$$\frac{dy}{dt} = 13.5 - 9.8t = 0$$

$$t = \frac{13.5}{9.8} = 1.38s$$

It reaches its highest point in 1.38 seconds.

c) At $t = 1.38$, $y = 13.5(1.38) - 4.9(1.38)^2$

$$y = 9.298$$

The golf ball rises to a maximum height of about 9.3 metres.

d) The golf ball lands when y = 0.

$$13.5t - 4.9t^2 = 0$$

$$t(13.5 - 4.9t) = 0$$

$t = 0$ is the initial time, so we want $t = \frac{13.5}{4.9} = 2.76s$

The golf ball lands 2.76 seconds after it is fired.

e) Horizontally, the golf ball travels

$$x = \frac{27\sqrt{3}}{2} \times 2.76 = 64.536,$$

which is about 64.5 metres.

We now consider a function whose domain is a set of real numbers and whose range is a set of vectors in R^3.

Let f, g, and h be real-valued functions of a real variable t. Then, for every number t in the domain common to f, g, and h, there is a vector F, defined by $F(t) = f(t)\hat{i} + g(t)\hat{j} + h(t)\hat{k}$, which is a vector equation of the curve C.

The derivative of $F(t)$ is defined in a familiar way.

$$\frac{dF}{dt} = \lim_{\Delta t \to 0} \frac{F(t + \Delta t) - F(t)}{\Delta t},$$

which is the definition of the derivative for the theorem:

If $F(t) = f(t)\hat{i} + g(t)\hat{j} + h(t)\hat{k}$, where f, g, and h are differentiable functions, then $F'(t) = f'(t)\hat{i} + g'(t)\hat{j} + h'(t)\hat{k}$

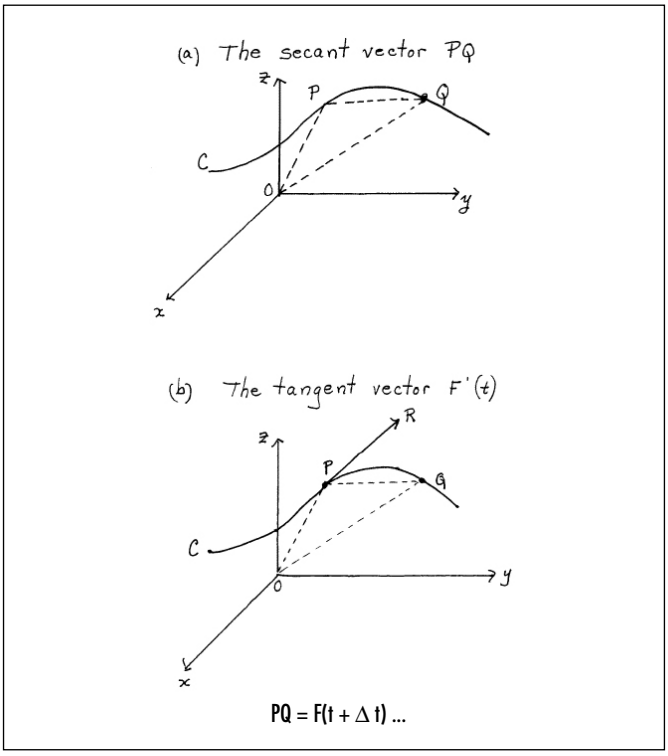


Figure 2. The secant vector and the tangent vector

Example 2

a) Find the derivative of

$$F(t) = (1 + t^3)\hat{i} + te^{-1}\hat{j} + \sin(2t)\hat{k}.$$

b) Find the unit tangent vector at the point where $t = 0$.

Solution:

a) $F'(t) = 3t^2\hat{i} + (1e^{-t} - te^{-t})\hat{j} + 2\cos(2t)\hat{k}$

b) $F(0) = \hat{i} + 0 + 0 = \hat{i}$ at $t = 0$

$F'(0) = 0 + \hat{j} + 2\hat{k}$ at $t = 0$

The unit tangent vector at the point (1,0,0) is defined to be the unit vector of the vector $F'(t)$ called $T(t) = \frac{F'(t)}{|F'(t)|}$

$$T(0) = \frac{\hat{j} + 2\hat{k}}{\sqrt{1^2 + 2^2}} = \frac{1}{\sqrt{5}}\hat{j} + \frac{2}{\sqrt{5}}\hat{k}$$

Now we can see that rates of change involving three-dimensional shapes can be discussed using parametric equations involving the R^3 unit vectors.

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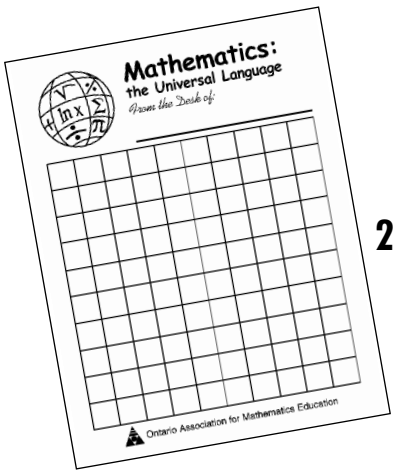
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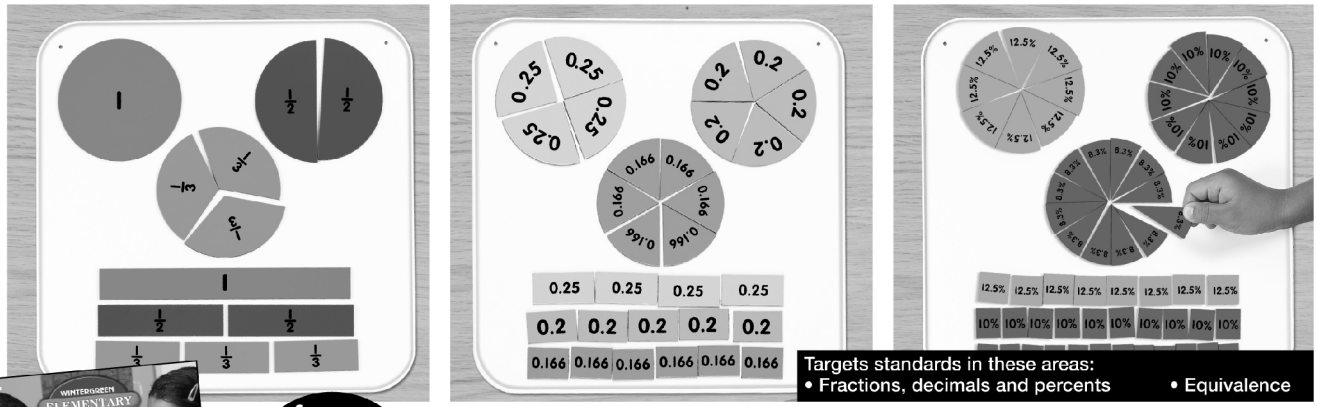


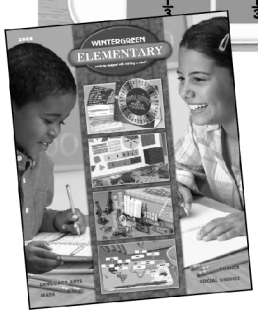
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▲ Directors' Dialogue

ANN MICHELE STENNING



Ann Michele Stenning is a mathematics teacher at South Secondary School with the Thames Valley District School Board. Having finished her Masters of Education degree in Curriculum Studies, she is currently assisting other parent volunteers with the development of weekly literacy activities, which she and other moms provide to at-risk students.

Board of Directors Meeting, October 3–4, 2008, Holiday Inn Select, Toronto Airport

Meetings

Conference Chairs

OAME's executive directors, along with the chairs of OAME's annual conferences for 2008, 2009, and 2010, met to share ideas and strategies. MCIS (Mathematics Conference Information System) information was provided by Greg Clarke and Cathy Lynch.

Chapter Representatives

Chapter representatives were told that chapter conferences can now use MCIS to register conference participants and to obtain payment. To do this, they must contact Cathy Lynch, the new MCIS Administrator, who can be contacted at MCIS@oame.on.ca. The chapter representative from Y^{4}MA announced plans to host a spring conference with Marian Small. The GOLDEN representative shared a telephone number used to obtain the game Math Scramble. Information about the game can be obtained by calling (843) 448-9329. During a discussion on teacher collaboration, guest Lyn Vause gave a presentation entitled "Teacher Collaboration: Models That Work."

Board of Directors

Anna Jupp, OAME's president, began the meeting by noting the influence that mathematics teachers had on Bill Cosby and Jane Goodall. Anna reminded everyone that this year would focus on mathematical connections. Greg Clarke thanked the Board for hiring two assistants to help with the technological side of OAME. Greg Rodrigo, a former Computer Science head from Dufferin-Peel CDSB and now a Georgian College professor, will be Greg's web assistant, doing day-to-day regular work. Greg also introduced Cathy Lynch, the new MCIS administrator. Cathy lives in London, is active in WOMA, and was co-chair of OAME 2006. She has already started helping chapters like CHAMP with MCIS. Cathy is also available to assist with the annual conference. This will free up Greg so that he can develop OAME's website by adding new features.

Laurie Moher, the new NCTM representative, announced that there are four new books for Grades 9–12, covering Problems, Math Connections, Measurement, and Number. Laurie also mentioned a research-based publication entitled *Technology in Teaching and Learning.* Finally, *Learning Environments That Support Math Understanding*, the "focus issue" of *Teaching Children Mathematics*, is also available.

Connie Quadrini and Gina Micomonaco reported on OAME's 2008 conference, "The Path Is Made by Walking," which featured lunchtime keynote speakers Marian Small and Marc Kielburger. The co-chairs offered tips on how to run a successful conference. Among these tips was a suggestion that organizers enlist the help of local boards of education for supply time, conference registration, audiovisual and technology equipment, IT support, secretarial assistance, and so on. They also suggested that future co-chairs consider aligning board professional learning plans, such as differentiated instruction, with conference themes. Anna Jupp then congratulated the co-chairs and presented them with plaques for their outstanding leadership.

Jacqueline Hill reminded Board members of the upcoming Board nomination deadline of January 16, 2009. The positions of President-Elect, Vice-President, and directors are available, and nominations can be accessed through the OAME website. Board members then visited the three remaining stations of a carousel activity that began at the last Board meeting in June. Anna Jupp finished the Board meeting by showing a video entitled *Do You Believe in Me?*

Saturday, October 4, 2008

Board Meeting

Sue Melville, chair of the Equity Committee, reported that the committee's third book study was on *Differentiated Assessment in Middle and High School Classrooms,* by Deborah Blaz. Committee members all agreed that this was an excellent resource, full of

practical, easy-to-implement ideas for the classroom. Sue noted that the committee members see a need for more grade books that reflect differentiated assessment. There was some discussion about next steps, which could include setting up a subcommittee to develop sample differentiated assessments and/or a sample differentiated grade book.

Board members were told that the OAME 2009 Equity speaker will be Kelly-Lee Assinewai, a Native Support Worker in the N'Swakamok Friendship Centre Alternative School in Sudbury. She will speak about the N'Swakamok approach to education and about their challenges and successes. A follow-up panel discussion on alternative schools will follow later in the day on Friday, May 15.

CHAPTER REPORTS

CHAMP — Rep: Shaun Knowles

Our Fall Event will host Trevor Brown as the keynote speaker, and the evening will be filled with interesting breakout sessions. Registration is being done through MCIS. As well, CHAMP is preparing for an exciting year of math contests and awards nights.

COMA — Rep: Pat Kehoe

As COMA is hosting the 2009 provincial math conference, we kicked off this exciting year with a fall social held on September 25. Dr. Marian Small was our guest speaker, and participants were treated to drinks and dinner while we heard Marian speak about piquing the curiosity of students who are disengaged. COMA invites all OAME members to consider attending the provincial conference on May 14–16, 2009 in our nation's capital! The theme for the conference is "Balance: Finding the Right MIXX." Details are available at **http://oame.on.ca/OAME2009**.

GOLDEN — Rep: Laura Tonin

We are currently in the beginning phase of organizing OAME 2010. Our committee chairs are planning the speakers, sponsors, themes, and social events. As well, we will be having a logo design contest that students can enter.

GVMA — Rep: Rob Gleeson

The fall conference entitled "Mathematical Tricks and Treats" was held on October 23. Workshops included discussions about some of the newer revised courses. The keynote speaker was Jeanette Gascho.

ISOMA — Rep: Diane Lang

Last year's format, which included the Fall Conference, Spring Workshop, and Jr. Math Olympics, was well supported by mathematics teachers from independent schools in Metro Toronto and the surrounding area. We therefore plan to follow the same format this year. These formal programs complement the work of Charlotte Danard, who organizes frequent informal meetings of Math Leaders at the Granite Brewery. If you would like to learn more about these meetings contact Charlotte. Last spring, students from UCC, Havergal, BSS, and Crescent teamed up to participate in the Ontario Math Olympics at Trent University. It was a well-organized event, and our students thoroughly enjoyed themselves. OMO 2009 will also be held at Trent University. ISOMA's Jr. Math Olympics will be hosted this year in the spring by Bishop Strachan School. Carly Ziniuk at Bishop Strachan is the contact person. Your ISOMA executive still needs suggestions with respect to planning a Spring Workshop. Let us know your interests and consider whether your school could host one of these events. We are always looking for new blood to join the executive or simply help with the planning of events. It's easy and it's fun. If you would like to get more involved, please contact our President, Bob Perrier

MAC² — Rep: Michele Walma

Our fall mini-conference had Kathy Kubota-Zarivnij as keynote speaker. She highlighted an instructional strategy called *Bansho*. Participants then focused on what the strategy would look like in each of the primary, junior, and intermediate/senior divisions. We continue to educate parents in mathematics via the Roadshow, during math nights, or through school councils. Greg Clarke, our newly appointed Technology and Website Coordinator, has shown us how to use *Adobe Connect* to invite members from distant areas to participate in our meetings. We will test *Adobe Connect* at our next meeting.

NOMA — Rep: Carol Lemmon

No report.

NWOAME — Rep: Tom Boland

NWOAME had a social evening with guest speaker Dr. Walter Whitely from York University. The evening social also featured a NWOAME/OAME information session and introduction, as we have many new members in our chapter. We are also in the planning stages for several other events, including a celebration of Pi Day, (or Pi Week, in our case), in March.

PRMA — Rep: Sandra Jean Price

We are very excited to welcome

some new members to our executive this year, and we are looking forward to their input. We are currently re-establishing our committees for the hosting of OMO 2009. This event will again be held at Trent University on May 29 and 30, 2009. We hope that our sponsorship campaign will be as successful as the one we ran last year.

QSLMA — Rep: Robert Sherk

The QSLMA executive met last June to begin planning for our annual fall conference. Unfortunately, the mini-conference will have to be postponed until the new year in order to allow more time to arrange for speakers and workshop leaders. Anyone who would like to present a session at our conference is welcome to contact Robert Sherk. The event will probably take place on a Saturday morning in late January. In the meantime, executive members plan to meet with local leaders in math education to seek their support in planning and attending QSLMA-sponsored events and in planning the provincial conference sometime in the next few years.

SAME — Rep: Debbie Drape

SAME hosted a mini-conference at Agincourt C.I. We have started planning for our local OMO as well. It is to be held at Henry Kelsey SPS, with the proposed date being the last Saturday in April.

SWOAME — Rep: Nicholas Chevalier

SWOAME is still in the process of submitting a proposal to host OAME 2011.

TEAMS — Rep: Laurissa Werhun

TEAMS is working on a new web page, **www.mathteams.ca**, to better serve the needs of our members. The TEAMS Math Olympics will be held on April 18, 2009 at the Catholic Education Centre in Toronto. Students from Grades 7 and 8 from both the Catholic and public school systems can compete for places on the TEAMS OMO team.

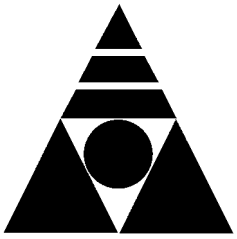
The TEAMS executive has currently started planning for hosting the Ontario Mathematics Olympics in 2011.

WOMA — Rep: Ann Michele Stenning

WOMA will be designing a poster of acronyms to be placed in the math departments of high schools and in staff rooms of elementary schools. This is to be an annual publication that endeavors to keep educators up-to-date with current math projects and initiatives.

Y^{4}MA — Rep: Ada Cartaginese

Y^{4}MA is planning to host a spring conference. Dr. Marian Small has been invited to present on Differentiated Instruction. The proposed format will be a plenary, with hands-on opportunities within division groupings. The tentatively scheduled date is April 30, 2009 at St. Elizabeth CHS in Thornhill. ▲

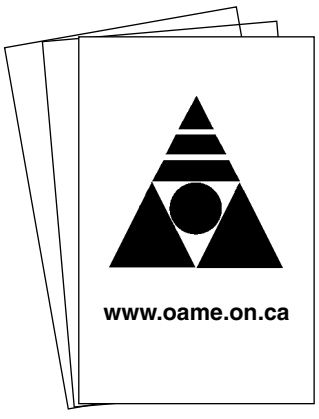


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