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Mathematics Student Wins the Siemens-Westinghouse Competition

Michael Viscardi, a senior high school student who is home-schooled, has won the 2005-06 Siemens Westinghouse Competition in Math, Science and Technology with a mathematics project dealing with the Dirichlet Problem. The results of the competition were announced on December 5, 2005. A project in Genomics won the team prize.

The Siemens Westinghouse Competition is a program of the Siemens Foundation and is administered by the College Board. The 2005-06 Finals were hosted by New York University, where the winners were announced. Two $100,000 prizes are given: one for an individual project, and one for a team project. Michael Viscardi won the prize for his project, *On the Solution of the Dirichlet Problem with Rational Boundary Data*. The team award went to Anne Lee and Albert Shieh, who developed an improved software package for analyzing genetic data; their project title was *SNiPer: Improved SNP Genotype Calling for Affymetrix 10K GeneChip Microarray Data.*

The Dirichlet Problem asks for a harmonic function on a domain R with prescribed values on the boundary of R. It was a recurring theme in 19th century mathematics, playing an important role in the development of potential theory and mathematical physics. The existence and nature of solutions depends, of course, both on the type of region and on the boundary conditions. Viscardi's work dealt with the case when the boundary values are rational functions.

Viscardi is home-schooled, but he has also had the opportunity to take courses at the University of California in San Diego. For his project, he was mentored by Peter Ebenfelt of UCSD. Steven Krantz of Washington University in St. Louis was one of the judges. He is quoted by the Siemens-Westinghouse press release: "Mr. Viscardi dazzled us with his creative use of the mathematical language. His research is profound, substantial and complete, with potentially important practical applications in heat flow, magnetism, electrodynamics and other branches of physics."

In addition to being a talented young mathematician, Viscardi is also an accomplished pianist and violinist, as well as a composer. He is concertmaster of the San Diego Youth Symphony and San Diego Youth Symphony Philharmonia, as well as first violinist of the San Diego Youth Symphony String Quartet. He plans to study mathematics and music in college.

Symposium on Kurt Gödel

Westmont College in Santa Barbara, CA, will be hosting an interdisciplinary symposium in honor of Kurt Gödel on February 3–4, 2006 (Friday to Saturday). The two day event will celebrate the 100th anniversary of Gödel's birth, and the 75th anniversary of the publication of his famous incompleteness theorems. Invited speakers include Mic Detlefson (University of Notre Dame), Daniel Isaacson (Wolfsom College, Oxford), and Mike Stobb (Calvin College). The talks, beginning at 3:30 p.m. on Friday in Hieronymus Lounge, will focus on the influence of Gödel's theorems in mathematics and the implications that many thinkers have drawn from them in areas such as artificial intelligence and the philosophy of mathematics. On Friday evening at 7:30 p.m. there will be a reader's theatre presentation in Porter Theatre of *Incompleteness: A Play and a Theorem*, by Apostolos Doxiadis. The workshop will conclude Saturday at 4:00 p.m. For further information contact Professor Russell Howell, Department of Mathematics and Computer Science, Westmont College, howell@westmont.edu.

Searchable Putnam Career Path Web Site

A new web site has been created for the purpose of providing a searchable data base for information about Putnam Fellows (the top five finishers in the Putnam Competition). The goal is to give the year of the competition, the home institution, the school from which the Fellow received a Ph.D degree, professional positions, and awards and honors for each Putnam Fellow . Of the 252 people who have been Putnam Fellows, the web site has PhD information about 164. The top six schools where Putnam Fellows have obtained a PhD are: Harvard (48), Princeton (35), Berkeley (21), MIT (19), Chicago (8), Stanford (8). The web address is http://www.d.umn.edu/~jgallian/putnamfel/PF.html. Users are invited to submit additional information about Putnam Fellows online.

2006 MAA TENSOR Grants for Women and Mathematics Projects

The MAA plans to award grants for projects designed to encourage college and university women or high school and middle school girls to study mathematics. The Tensor Foundation, working through the MAA, is soliciting college, university, and secondary mathematics faculty (in conjunction with college or university faculty) and their departments and institutions to submit proposals.

Grants will be up to $5,000 and will be made to the institution of the project director to be spent within the year. College and university mathematics faculty, or secondary school or middle school mathematics faculty working in conjunction with college or university faculty, are eligible for TENSOR grants. Proposals will be due in early February, 2006. Complete details are available through the MAA website at http://www.maa.org/projects/tensor_solic.html.

MAA Announces Search for Director of Publications

The Mathematical Association of America (MAA) is seeking a highly qualified person for the position of Director of Publications. A candidate should have a significant record of work in publications in the mathematical sciences; a Ph.D. or other advanced degree in a mathematical science or related field is preferred. The position requires successful experiences in some of the following areas: book publishing; journal production; administration including financial management; editorial/reviewing experience; mathematical writing not limited to research publications; and electronic publications. Interest and experience with the use of the internet in publications, grants, personnel management, and marketing experience are desirable. Appointments may be made for two or three years, with the option of renewal for multiple years.

The Director will oversee a staff of six located in the headquarters office and numerous editors. S/he oversees publication of three journals, three magazines, nine book series, and a variety of columns and articles. Electronic publications include all of these types of materials as well as the MAA Mathematical Sciences Digital Library (MathDL). The Director's duties include personnel management, financial administration, acquisitions, production, grant proposal writing and project management, and marketing. The Director reports to the Executive Director. S/he is a key member of the MAA's staff leadership team, and will work closely with the Executive Director and other staff members, national officers, section officers, committee chairs, and others in strategic planning and program development.

The MAA, with nearly 30,000 members, is the largest association in the world devoted to college level mathematics. Membership includes college and university faculty and students, high school teachers, individuals from business, industry, and government, and others who enjoy mathematics. The Director of Publications is responsible for ensuring that publications encompass the interests of all major constituencies of the MAA, embrace all areas of mathematics, and are easily available to all our members and the larger community who are interested in mathematics, especially expository mathematics and materials for faculty and students.

The deadline for submission of applications is January 21, 2006. Interviews will be held during the months of January and February. It is expected that the new Director will begin work by July 2006, earlier if possible. The position is located at the national headquarters of the MAA in Washington, DC. Salary will be based upon the candidate's credentials or current salary for a reassignment position. The MAA offers a generous benefits package.

Candidates should send a resume and letter of interest to:

Ms. Julie Kraman
Mathematical Association of America
1529 18th Street, NW
Washington, DC 20036.

Applications may be submitted electronically to jkraman@maa.org. References will be requested after review of applications. Applications from individuals from underrepresented groups are encouraged. Additional information about the MAA and its publication programs may be found on MAA's website: http://www.maa.org . AA/EOE.

The Sudoku Epidemic

By Robin Wilson

The sudoku craze has become an epidemic. Originating in the US and Japan, and hardly known a year ago, it has since swept the world, infecting much of Europe, Australia and Asia before returning to the US. So what is sudoku, where did it come from, and how does one solve it?

What is sudoku?

Sudoku (or su doku) is a number puzzle, usually consisting of a 9 x 9 grid divided in nine 3 x 3 boxes, into which numbers already appear in a few cells. Here's an example (Puzzle 1):

9					7		1	
	7	4			2		6	5
	1		8	9		4		
2				8		5	9	
1			2		3			6
	4	5		1				2
		7		4	1		2	
3	2		9			8	5	
	6		5					7

Puzzle 1

The object of the puzzle is to complete all the remaining cells with the numbers from 1 to 9, so that:

- *each row contains all the numbers from 1 to 9*
- *each column contains all the numbers from 1 to 9*
- *each 3 x 3 box contains all the numbers from 1 to 9*

The completed pattern is thus a 9 x 9 Latin square with an extra condition on the 3 x 3 boxes.

A well-constructed sudoku puzzle has only one solution which one can find by proceeding in a logical step-by-step manner. The solution to Puzzle 1 is given on page 25, but you may wish to try it for yourself first.

Because of the simplicity of its rules, sudoku has caught the imagination of young and old alike. Its popularity arises partly from the fact that the puzzles can vary in difficulty from the easy to the extremely hard, depending on how many numbers are given and where they're placed, so solvers can choose a puzzle to match their level of ability.

Why 'sudoku'?

Despite its name, sudoku isn't of Japanese origin. Claims have been made that the puzzle can be traced back to Euler in the 18th century, but these claims are incorrect – Euler certainly worked on Latin squares, but never considered the extra condition on the 3 x 3 boxes. In fact, the first known sudoku puzzle appeared in a New York puzzle magazine in 1979, under the name of *Number place*.

The puzzles didn't reach Japan until the mid-1980s. The puzzle company Nikoli saw an American number place problem and introduced it to the readers of their puzzle magazine in 1984 under the name ***Su**nji wa **doku**shin ni kagiru*, shortened to *sudoku* – meaning 'single number' because just one number appears in each cell. They soon became highly popular, and currently some 15 Japanese sudoku magazines and 30 books are published monthly, catering to half a million readers.

In 1997, Wayne Gould, a retired High Court Judge living in Hong Kong, discovered sudoku in a Tokyo puzzle book. Fascinated, he spent the next few years designing computer programs to produce sudoku puzzles of varying difficulty which he then provided for newspapers around the world.

In 2004, Gould sent one to *The Times* in London, who published their first puzzle in November – his puzzles still appear, in four levels of difficulty (easy, mild, difficult, and fiendish). Other newspapers followed suit, and by Easter 2005 a huge cottage industry had developed, with most British newspapers including daily sudoku puzzles and rivalling each other to offer prizes for solutions to puzzles of ever-increasing complexity and originality. These now include 16 x 16 sudoku grids, grids of five linked 9 x 9 sudoku puzzles (none completable on its own), and *The Times* 'killer puzzles' in which the numbers in certain subsets of cells have specified sums. There is even a three-dimensional sudoku puzzle in the form of a 9 x 9 x 9 cube.

In May 2005 the sudoku craze suddenly spread around the world. Within a month sudoku puzzles had appeared in newspapers in Australia, Canada, Israel, Eastern Europe, and India, and they have recently returned to haunt the United States, now appearing in many dozens of American newspapers.

Further historical notes can be found in [**5**].

Solving a sudoku puzzle

Suppose that you are given the sudoku puzzle on the right to complete (Puzzle 2).

We'll call the rows $A, B, \ldots, I$, the columns $a, b, \ldots, i$, and the 3 x 3 boxes ❶,❷, . . . ,❾, proceeding horizontally from top-left (box ❶) to bottom-right (box ❾). We denote cells by their row and column letters – for example, *Cf* is the cell in row *C* and column *f* (containing 9).

There are several techniques that you can use to solve sudoku puzzles, such as: *scanning rows and columns*, *filling in the gaps*, and *filling in single cells*; further details can be found in [3]:

Scanning rows and columns

Look first at columns *d*, *e*, *f* of Puzzle 2. In these columns, each number from 1 to 9 must appear three times in total, once in each column and once in each 3 x 3 box; for example, the number 3 appears in cells *Bf* (box ❷ and column *f*), *Ee* (box ❺ and column *e*), and *Gd* (box ❽ and column *d*). It follows that:

- the third appearance of 9 must be in cell *Id*
- the third appearance of 5 must be in cell *Ad*

In the same way, we notice that:

- in rows *G*, *H*, *I*, 5 must be in cell *Ii* (since 5 already appears in column *h*)
- in columns *g*, *h*, *i*, 6 must be in cell *Hi* (since we have just put 5 in cell *Ii*)
- in box ❺, 6 cannot be in rows *D* or *E*, so must be in row *F*, in cell *Fd*; similarly, 7 must be in cell *Ff*

More subtle is the following:

- in box ❾, 8 is in column *g*; in box ❻, 8 cannot be in column *g* or row *E*, so must be in column *i*, in cell *Di* or *Fi*; thus, in box ❸, 8 must be in column *h*, in cell *Ah*

Filling in the gaps

When rows, columns and boxes are almost complete, we can sometimes fill in the missing entries; for example:

- in column *d*, only 1 is now missing – so put 1 in cell *Dd*
- in box ❺, only 4 is now missing – so put 4 in cell *Df*
- in column *f*, 1 and 2 are missing, but we cannot yet decide where to put them

Filling in single cells

	a	b	c	d	e	f	g	h	i
A			4				6		
B		2		4		3		1	
C	1			8		9			4
D		7			5			6	
E				2	3	8			
F		1			9			5	
G	5			3		6			7
H		9		7		5		2	
I			7				8		

Puzzle 2

Look at cell *Bi*. It cannot contain 1, 2, 3 or 4 (already in row *B*), 5, 6 or 7 (in column *i*) or 8 (in box ❸), so must contain 9; we can then put 9 in cell *Aa*.

Similarly, cell *Ab* cannot contain 4, 5, 6 or 8 (already in row *A*), or 2, 7, 1, 9 (in column *b*), so must contain 3.
Note also that in column *b*, the only place that we can put 8 is in cell *Gb*; we can then put 8 in cell *He*.

Using small numbers

We could continue like this, but another approach is to write in each square the possible numbers that can be inserted. For our puzzle the current position is:

	a	b	c	d	e	f	g	h	i
A	9	3	4	5	127	12	6	8	2
B	678	2	568	4	67	3	57	1	9
C	1	56	56	8	267	9	2357	37	4
D	238	7	2389	1	5	4	239	6	238
E	46	456	569	2	3	8	1479	479	1
F	2348	1	238	6	9	7	234	5	238
G	5	8	12	3	124	6	149	49	7
H	34	9	13	7	8	5	134	2	6
I	2346	46	7	9	124	12	8	349	5

Puzzle 2 (continued)

Note that:

- in cells *Ai* and *Ei*, only one number can be inserted, thereby enabling us to fill in further squares
- in box ❶, the cells *Cb* and *Cc* must contain 5 and 6 (in some order), so cell *Bc* must contain 8 and cell *Ba* must then contain 7

Continuing in this way, you should be able to complete the puzzle – the solution is on page 25.

Some mathematics

A number of interesting mathematical problems arise in connection with sudoku. The number of possible 9 x 9 Latin squares is

5,524,751,496,156,892,842,531,225,600;

how many of these are valid sudoku grids? In June 2005, this number was found by Felgenhauer and Jarvis [**1**] to be

6,670,903,752,021,072,936,960.

Later, the number of 'essentially different' grids (once relabelling of the nine symbols and obvious row and column permutations have been eliminated) was found by Russell and Jarvis [**2**] to be 5,472,730,538.

It is also natural to ask for the maximum and minimum number of filled-in cells for a sudoku puzzle to have a unique solution. The maximum number is 78 – if from the solution of Puzzle 2 the 1s and 9s in positions *Aa*, *Af*, *Ca* and *Cf* are erased, leaving 77 filled-in cells, the puzzle cannot be uniquely completed. The minimum number seems to be 17. There are several known examples with 17 filled-in cells which can be completed uniquely, but no-one has found one with just 16 filled-in cells, or proved that none can exist. Further information can be found in [**5**].

Summing up

It only remains to wish you all the best in your sudoku explorations. Solving these puzzles can be very frustrating at times – but it can also be enormous fun! We conclude with a puzzle (Puzzle 3) containing nine letters – if you complete it correctly, a hidden mathematical word will appear in one of the rows or columns; the solution is given on page 25. Further word puzzles can be found in [**4**].

				H	T		G	
T								
		R	M			H		
H			L		I	O		
G								A
		L	T		R			M
		O			H	I		
								L
	M		O	R				

Puzzle 3

Robin Wilson is a Professor of Pure Mathematics at the Open University, Gresham Professor of Geometry in London (the oldest mathematical chair in England, dating from 1597) and a Fellow of Keble College, Oxford University. He has written and edited about thirty books on subjects ranging from graph theory and the history of mathematics to music, philately and sudoku. He is internationally known for his bright clothes and his awful jokes.

References

1. B. Felgenhauer and F. Jarvis, Enumerating possible Sudoku grids, http://www.shef.ac.uk~pm1afj/sudoku/sudoku.pdf.
2. E. Russell and F. Jarvis, There are 5472730538 essentially different Sudoku grids …, http://www.shef.ac.uk/~pm1afj/sudoku/sudgroup.html.
3. R. Wilson, *How to Solve sudoku: A step-by-step guide*, Infinite ideas, 2005.
4. R. Wilson, *Hidden Words sudoku*, Infinite ideas, 2005.
5. A useful website that gives information about all aspects of sudoku and is updated regularly is http://en.wikipedia.org/wiki/Sudoku.

Archives of American Mathematics Spotlight: The Bryce S. DeWitt Papers

By Kristy Sorensen

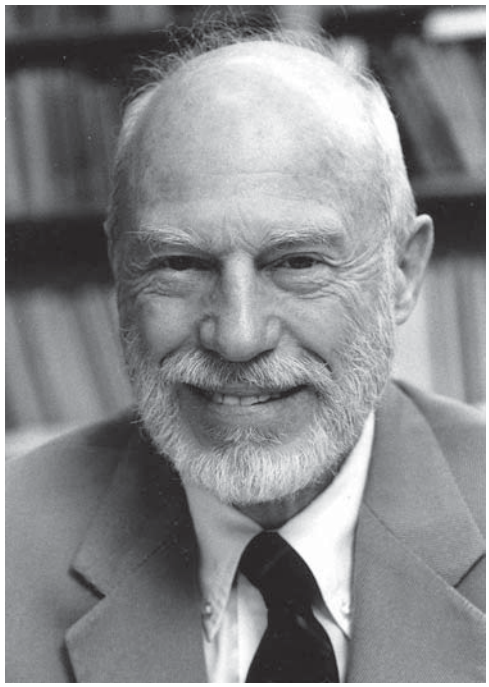
The Archives of American Mathematics at the Center for American History has recently made available the Bryce S. DeWitt Papers, a growing collection documenting the research work of this important physicist. At this time, the papers include handwritten notes, correspondence, and printed material; as well as extensive documentation of the ground-breaking 1973 eclipse experiment (described below), including 85 glass photographic plates taken during the period of the experiment and computer print-outs analyzing the data.

Bryce S. DeWitt (1923-2004) was known for his mathematical approach to physics and his work in quantum field theory, supermanifolds, gauge theory, and relativistic astrophysics. DeWitt received all three of his degrees in physics from Harvard University (Ph.D. in 1950). His doctoral studies also involved a stay at the Institute for Advanced Studies, where he met his wife, the physicist Dr. Cecile DeWitt-Morette.

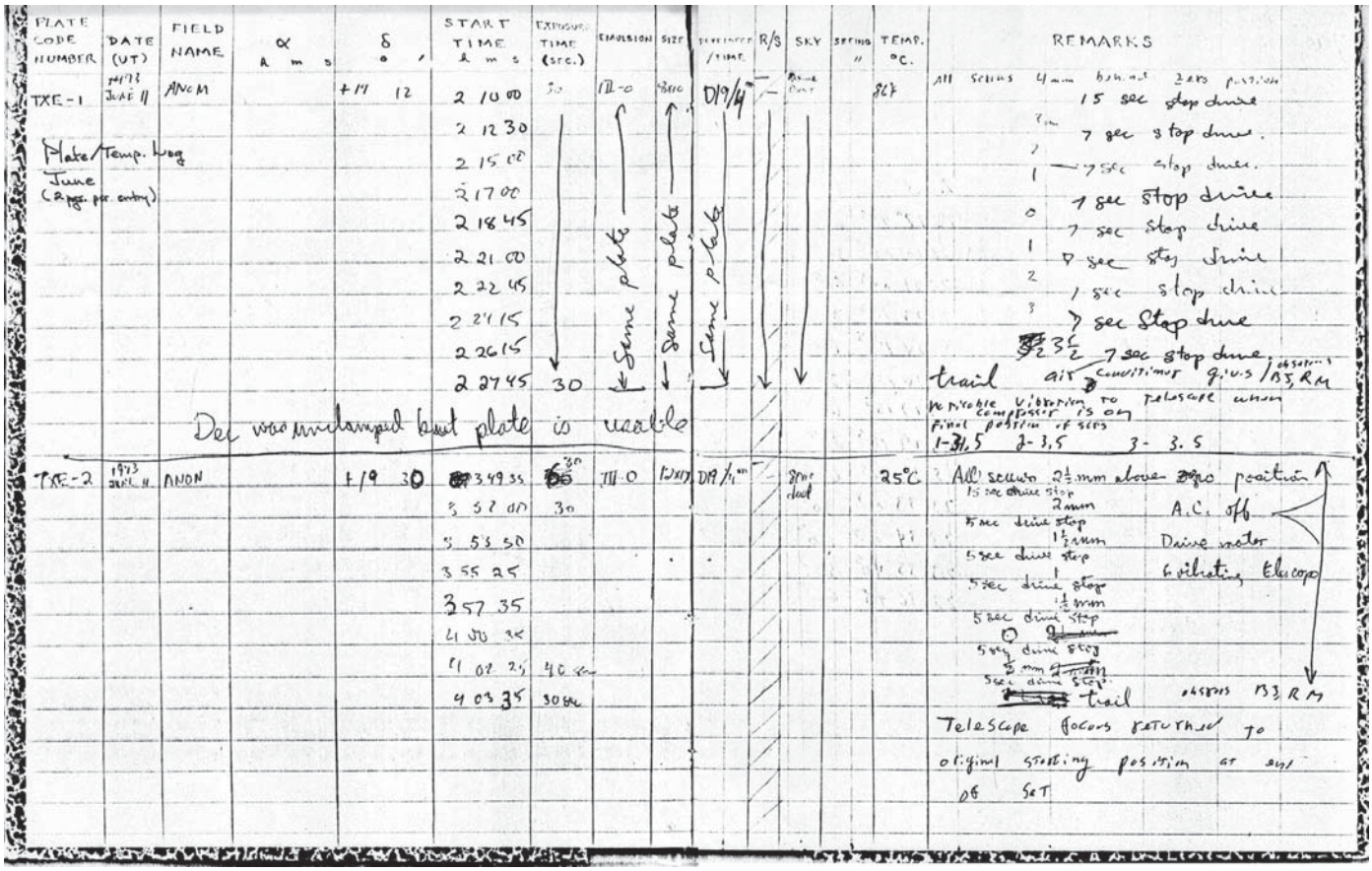
In 1973 DeWitt and DeWitt-Morette led a scientific expedition to Mauritania to test Einstein's general relativity theory of gravity during a total solar eclipse, an experiment that had been tried nearly thirty times before with mixed results. A series of photographic plates were taken during the eclipse and compared with a set of plates taken of the night sky six months later. Analysis of these photos later proved that the stars had been pulled out of their original paths by the sun's gravity, just as predicted in Einstein's theory. *Harlan's Globetrotter's*, a recently published book by David S. Evans and Karen I. Winget (Xlibris, 2005), explores the story of the 1973 eclipse experiment in great detail.

The glass plates are organized by size and generally include the inventory number assigned to them at the time of the experiment. These include many practice plates taken before the eclipse itself. The "suitcase plates" are the most valuable of the glass plates and were carefully escorted from the experiment site by Cecile DeWitt-Morette in a foam-padded, metal suitcase for analysis. A complete log of the glass plates, descriptions of the

Bryce S. DeWitt and Cecile DeWitt-Morette hiking in the French Alps, July 1963. Photo by Kip Thorne of Caltech, courtesy of Chris DeWitt.



Bryce S. Dewitt, 1990. From the Office of Public Affairs Records, Center for American History, Archives of American Mathematics.



A working log of the astronomical plates kept during the 1973 eclipse experiment in Mauritania. From the Bryce S. DeWitt Papers, Archives of American Mathematics, Center for American History, The University of Texas at Austin.

experiment, and computer analysis of the data are available in collection. Due to the fragile nature of the glass plates, they are available by appointment only.

DeWitt was a dedicated teacher and researcher; he held positions at the Institute for Advanced Study, the Lawrence Livermore National Laboratory and the University of North Carolina at Chapel Hill before beginning his professorship at The University of Texas at Austin in 1972. At UT Austin, DeWitt served as the director of the Center for Relativity (1972-1987), Jane and Roland Blumberg Professor of Physics (1986-2000), and Professor Emeritus (2000-2004). DeWitt's awards include a Dirac medal from the Salam International Center for Theoretical Physics in Italy (1987), the Pomeranchuk Prize of the Institute of Theoretical and Experimental Physics in Moscow (2002), the Marcel Grossman Award (with Cecile DeWitt-Morette, 2002), the Einstein Prize of the American Physical Society (2005), and election to the National Academy of Sciences (1990) and the American Academy of Arts and Sciences (2002).

Intellectual Nomads, an upcoming collection edited by Cecile DeWitt-Morette and John Stachel will include a volume entitled *Quantum Gravity: Memoirs of Bryce S. DeWitt*.

The finding aid for the Bryce S. DeWitt Papers is available online at http://www.lib.utexas.edu/taro/utcah/00413/cah-00413.html.

The Archives of American Mathematics is located at the Research and Collections division of the Center for American History on the University of Texas at Austin campus. Persons interested in conducting research or donating materials or who have general questions about the Archives of American Mathematics should contact Kristy Sorensen, Archivist, k.sorensen@mail.utexas.edu, (512) 495-4539. The Archives web page: http://www.cah.utexas.edu/collectioncomponents/math.html.

Afghanistan: Mathematics Education Reconstruction Efforts

By James R. Kennis

It was April 2004. The school year was coming to an end and my high school freshman and sophomores were beginning to bounce off the walls as they began to feel the first signs of spring in a public NYC school. Aside from my thesis work, I was wondering how and where I would spend my summer vacation.

Late that month, I received a call from Teachers College at Columbia University.

"Hello?"

"Hello. I work for the Teachers College/ Columbia University Afghanistan Project (TCCU). You have been recommended as someone who may be interested in working in Afghanistan as a mathematics education consultant. Would you be willing to come to my office to discuss this matter?"

"Uhh… okay (Afghanistan?)."

After an interview where I highlighted my Peace Corps service, cultural sensitivity, mathematics teaching experience, and doctoral work, it was concluded that I was qualified for the job. I agreed to go work with the Ministry of Education (MOE) in Kabul for five weeks along with a small team of other graduate students with different areas of expertise.

My job would be to write a second grade mathematics syllabus (scope and sequence) with the Afghan mathematics team so that they could produce a new, student-centered textbook by December, 2004. I would arrive in Kabul on Sunday July 18th, 2004 and leave Kabul on Sunday August 21st, 2004; a stay of precisely five weeks.

Mathematics Education Pre- and Post Taliban

The education system of Afghanistan has been confronted with numerous changes owing to the actions of the many different social forces and, occasionally, due to sudden changes that occurred in the culture. (For more information and details, see *Curriculum Framework, Afghanistan,* by the Ministry of Education, Compilation and Translation Department, 2003. This is cited below as MOE 2003.)

Kabul International Airport

In 1901, Amir Habibullah Khan succeeded his father to the throne of Afghanistan and laid the foundation for the education system by introducing the first secondary — all boys — school; named Habiba College. Because Indian educational professionals designed the curriculum for this school, numeracy and mathematical knowledge and skills were greatly emphasized. After Habibullah's assassination in 1919, King Amanullah Khan (1919–29) introduced several reforms intended to modernize Afghanistan. A centralized education curriculum was established and schools and universities — for boys *and* girls — were established in the capital and some provinces.

The education system did not undergo any significant reforms until 1973. At this time, Sardar Mohammad Daud Khan reinforced the former educational institutions. The curriculum was adjusted in accordance with the requirements of the time. It was during Daud's reign that Teachers College established a considerable force of educational consultants in the Ministry of Education. As many as 30 consultants from Teachers College were in place on every floor and in every department in the Ministry. Daud was assassinated in a coup on April 1978 and the following year, the Soviets took advantage of the instability and invaded Afghanistan.

With the Soviet invasion came the Teachers College withdrawal. Furthermore, this unwanted political regime drastically changed the country. The educational system was severely affected, if not altogether forgotten. During this time, mathematics textbooks became highly political and controversial. Problem sets often involved violence against the occupying Soviets. For example, "10 Soviet soldiers are in a helicopter. The helicopter is shot down by the Mujadeen freedom fighters and 7 Soviet soldiers are killed. How many soldiers remain to be killed?"

In 1989 the Soviets withdrew. This did nothing, however, to stabilize Afghani-

stan; instead, the Afghans fought a deadly civil war until the Taliban took over in 1998. At this time, the Taliban controlled over 90% of Afghanistan and the whole education system was set back hundreds of years. Girls were banned from attending school. The mathematics curriculum was de-emphasized and replaced by a conservative, religious education. The Taliban's reign ended with the fall of Kabul to American forces on November 13, 2001 and an Interim Administration of Afghanistan (IAA) was established with Hamid Karzai as chairman (he is now the elected President of Afghanistan).

The Soviets and the Taliban left the education system in Afghanistan severely impaired, if not in shambles. *U.S. News and World Report* listed the education system in Afghanistan as being the worst in the world! Probably, the worst of the ill effects was the closure of schools for girls in 1996. Females were banned from employment and confined to their homes. The curriculum provisions did not meet people's needs and did not prepare them to cope with today's challenges successfully. As a consequence, the quality of the curriculum decreased. In addition, because many different 'education systems' had been implemented; the curriculum was certainly not balanced and modern. Furthermore, twenty years of continuous armed conflict resulted in most of the schools being destroyed or severely damaged. Many experienced and well-educated teachers left the country and/or the education system.

The IAA quickly realized the impact of quality education and learning on personal and social development. It mandated the MOE to develop a new curriculum for all grades and types of school; which gradually began implementation in 2003. In preparing the new curriculum, policy education statements of the Government were of major importance. "In order to implement its education policy, the MOE has mandated a Commission of decision makers comprising of experienced education specialists from the Compilation and Translation Department to design a new curriculum in compliance with education policy orientations and general statements of the Transitional Islamic State of Afghanistan." (MOE, 2003)

The Teachers College at Columbia University began to work in Kabul with the MOE Department of Compilation and Translation in 2003, under a grant from UNICEF. I was hired by TCCU as a mathematics education curriculum specialist. The overall aim of the project was to assist the MOE with curriculum design and development as well as the writing of new, modern textbooks aligned with Afghanistan's culture and religious beliefs.

Expat Educator Living in Kabul

The first thing that you will notice when you arrive at Kabul International Airport and disembark from the plane is the searing heat, thick dust, and many small red flags stuck in the ground around the runway. Afghanistan, being the most heavily mined area in the world, has millions of unexploded weapons and the airport is no exception. The red flags remind you that the areas that surround the runway have not been cleared of mines.

Kabul, Afghanistan's capital, seems almost lawless. Between the U.S. Military, the Afghanistan Military, I.S.A.F. (International Security Assistance Force), city police, provincial police, C.I.A., security guards, citizens, DynCorp, and the warlords' personal armies; there are guns everywhere and it seems impossible to tell who — exactly — is carrying them.

As for the ever-permeating dust, hearsay among the overseas workers is that the Center for Disease Control (CDC) did a study that concluded that 30–70% of the dust in Kabul is fecal and it is not uncommon to contract a gastrointestinal illness within a week of arrival.

Virtually all of the overseas workers either stay in guesthouses or rent houses for their stay. Most of these facilities are U.N. approved, meaning that they must have a surrounding fence a certain height and armed guards 24 hours a day. We stayed in a guesthouse — one of only a few — that offers in-room cable Internet service. The TCCU project leaders stayed in a different guesthouse that also offered Internet. The average price for a room in a guesthouse is $40/day. Almost all of the guesthouses that cater to the overseas community have Western toilets, hot showers, and air conditioning; these amenities are not available to the traditional Afghan populace. The downside was that our guesthouse served food that was not palatable and all of the graduate students contracted one or more food-related illnesses that lasted the duration of our stay.

In Kabul, there are many restaurants that cater to the overseas community and many different ethnic cuisines could be found. All of these restaurants charge Western prices and therefore exclude the local Afghan population. Most of the 2000+ overseas workers regularly dine in these establishments because eating the food served in the guesthouses and/or the streets is usually a health hazard. With a U.S. passport and a United Nations Identification Card, you are allowed to go to the military base to buy Western groceries and allowed access to the U.N. Compound. The U.N. Compound has a clean swimming pool, pool tables, and volleyball court for entertainment. Going to the U.N. Compound gives the Western women — and men — a chance to wear shorts and short sleeved shirts.

The Afghan people are extremely kind and considerate of foreigners. Although always vigilant, at no time did I feel personally attacked or threatened. The work week is six days long with Friday being the day off. During a normal work day, I would wake up, eat, and get picked up around 8:00 a.m. from my guesthouse to be driven to the MOE, work until about 4:00 pm, be driven back to the guesthouse, work some more, and then — if I could find a ride — go out with friends to a restaurant for dinner.

Curriculum Work in the Ministry of Education

My job description in July was to write a 2nd grade mathematics syllabus, which was to be accomplished in five weeks. This was not to be a syllabus in the U.S. academic sense; instead, it was to be a scope-and-sequence on a grander scale. My job was to report to the MOE every

day and collaborate with the Ministry's mathematics education team to write the syllabus. I viewed this job as two-fold; 1) build confidence with my Afghan colleagues across cultural lines, and 2) assist the team in writing a syllabus that is mathematically and culturally sound. All work and discussions with the team were with a professor at Kabul University who served as my translator, friend and confidant.

The MOE's mathematics team consists of four men with various levels of mathematics education background. Their ages ranged from forty to sixty. These men made the equivalent of $35/month to work for the MOE and all of them had other jobs that paid more money, such as selling fruits and vegetables in the market. Morale was very low; the only resources that were available were the books that TCCU had previously brought and left with the team. On top of that, the MOE's expectations were high.

Afghan kids: globalization has reached here as well.

Prior to my arrival, the mathematics team had been working with non-mathematics curriculum specialists from TCCU and were shown many procedures and methodologies that were new and sometimes contradictory. This was frustrating for the team because they thought that they were being pushed in too many different directions. I suggested that we make a fresh start; they were happy to oblige. I spent the first week acquainting myself with the team and finding out important information that would assist in writing the syllabus, such as the number of mathematics teaching days in a school year, resources available to teachers, and what current Afghan textbooks were like.

My Afghan colleagues told me that there are 160 mathematics teaching days in a school year and there are no resources available to the underpaid and undereducated teachers: no paper, no pencils, no chalk, no board, and certainly no manipulatives to solidify mathematical understanding. Current textbooks in Afghanistan seemed to be behind the times and many textbooks contained misinformation or incorrect answers to the problem sets. Lastly, I learned that there is no such thing as a centralized school-year; this is due to the fact that the landscape of Afghanistan varies greatly in altitude and climate, thereby making the farming season and school year different for many of the tribal regions. Learning these facts from my Afghan colleagues made it clear that writing a syllabus would be impossible without their expertise and input.

I had brought several 2nd grade mathematics textbooks (mainly Western texts). I compared these to those of Afghanistan, Iran, and Pakistan. Because the MOE's mathematics team was very skeptical of a Westerner arriving and "telling them how and what to write in their textbooks," I was better able to serve them by discussing mathematics curriculum that is being used in neighboring, Muslim countries.

TCCU and UNICEF emphasized that the new Afghanistan syllabus is student-centered, with an emphasis on classroom activities. This is great in theory; selling this idea to four Afghan men who survived over 20 years of continuous fighting and believed in the drill-and-skill methodology was a daunting task. I was further hindered by knowing that there are no resources available to the teachers in Afghanistan; only a textbook. This forced me to not only consider the implications of the Afghan's educational beliefs but to seek overlap with TCCU/UNICEF's requested output.

After two weeks of discussions with the mathematics team, we realized that the syllabus, all 140+ lessons, would not be completed on time. We were spending a great deal of time talking and not enough time writing. This process was further hampered by the MOE's expectations from the team in regards to other projects. Aside from the syllabus project, the team had several other projects to consider — their plates were full. Thus far, working together, we had four lessons outlined and we needed — UNICEF needed — a complete 2nd grade syllabus in three more weeks. My Afghan colleagues decided that I should work alone, write the syllabus using Islamic and Western texts as references, and report to them as chapters were finished and translated so that they could use their experience to make thoughtful, relevant changes that fit their needs. I did not like the idea of writing the syllabus in isolation and knew that I would need the team's input. To make a thoughtful syllabus in Afghanistan requires the input and personal experiences from a team of Afghan educators. However, I received assurance from them that they would make important changes as necessary.

The final syllabus had 12 chapters and over 140 lessons; it was almost 200 typed pages and it needed to be translated so that the team could use it to write the new textbook. Almost every lesson was accompanied by a group activity. Bearing-in-mind the lack of resources, every activity was written so that the students and teacher would only need pebbles and/or sticks to run the lesson's activity.

When I left Afghanistan in August, the 2nd grade mathematics syllabus and solution sets were complete. We took an entire day using the syllabus as if we were beginning to write the new textbook. Furthermore, the team's confidence grew and they felt that they could write a respectable 2nd grade student-centered mathematics textbook.

I returned to NYC in August 2004 to continue work on my thesis.

Returning to Kabul

In September 2004, TCCU asked me to return to Afghanistan for ten weeks. The new job description was to complete the 2nd grade textbook and — time permitting — write the 3rd grade mathematics syllabus. Having already worked in the MOE and with the Afghan people, I knew what to expect.

When I returned in October, it was under the assumption that the mathematics team had already written the 2nd grade textbook and that I would consult them on technical issues. I was surprised to find that the textbook was not completed because the team focused their energy on other MOE projects. Furthermore, TCCU informed me that they needed a complete, new textbook by December 1st (in 6 weeks) and that I would be teaching classes to undergraduate students at the university while being observed by teacher-trainers. The 3rd grade syllabus still remained on my job description.

I quickly reacquainted myself with the mathematics team. Although I was surprised that the work had not been finished, I was very happy to see them again. We discussed the MOE's expectations of the textbook and decided to work together by having me write the lessons as a template and having the team make the necessary changes to suit their cultural and educational needs. As each chapter was finished and translated, copies would be given to the mathematics team for their assessment. After the team made any necessary changes, the chapters were given to the computer department in preparation of publishing the final textbook.

On December 1st, the completed text with 140 student-centered lessons was approved by my Afghan colleagues and given to TCCU.

Collaboration at a Normal University in Kabul

In November, TCCU invited me to teach a mathematics education course at Syed Jamaluddin (a Normal University). Although my current job description was already overwhelming, I was eager to get back into the classroom. Furthermore, this line of work was probably more important than working in the MOE because of the transformative potential of teaching and learning collectively with young, vibrant Afghans. I accepted the job.

The class would serve dual purposes because while I was teaching undergraduate pre-service teachers there would be a panel of teacher-trainers observing my methodologies. I thought this was a great plan. Everything that was said and taught in the classroom was done through a translator. Furthermore, TCCU decided to put together a teacher-training workbook. This meant that all of the lessons would have to be carefully outlined; complete with times and sometimes scripted.

The next step was to decide *what* to teach. Clearly, teaching topics that are not already discussed in Afghanistan is essential; moreover, these topics should be of critical value in terms of mathematics education. The decision was made that knowledge of problem-solving/critical thinking and children's mathematical thinking would — in the long run — assist the mathematics teachers of Afghanistan the most. Since most of the teachers in Afghanistan were lacking in mathematical skills; the algorithms for addition, subtraction, multiplication, and division, and the related methodologies for teaching these topics, would also be discussed in the class. Lastly, because most of the pre-service teachers have never taught or spoken in front of a class, students were placed into groups and assigned group project/presentations.

The first lesson was not entirely completed. I miscalculated the length of time the translation would add to the lecture, and most of the ideas that were discussed were original in Kabul. After this experience, the lessons were reevaluated and shortened. It was very refreshing to see that 40% of my students were women; if you consider the history of Afghanistan, this is an educational accomplishment in itself.

What's Next?

It is very difficult to acquire funding for curriculum projects. Most donors want to donate physical outputs, e.g. books, buildings, pencils, etc. As of now, TCCU is trying to team up with a larger organization that is also doing a lot of work in international education. If this happens, TCCU will lose its autonomy but will acquire the necessary funding to continue its much needed work in curriculum development in Afghanistan.

Although the work in Afghanistan was frustrating on many levels, it was also rewarding. Making a sustainable change is a slow process and working for an NGO (non-government organization) compounds this process because, as a foreigner, I needed to understand the culture, climate, and background before I could begin to assist the nationals with their needs and this takes time.

There are too many positive changes that are currently taking place in Afghanistan to list; everywhere you go, you are reminded of the strength and the hopes of the Afghan people.

In the education sector, the MOE is striving to make progress by building new schools, hiring teachers, publishing textbooks, and reestablishing a core curriculum that is more aligned with global educational thought. Furthermore, the MOE is willing to take risks to educate the Afghans and this is clearly shown by introducing a mathematics textbook that is student-centered and full of activities — unchartered territory in Afghanistan. The leaders at the MOE have seen the negative impact created by not educating the population and are eager to remedy this situation. This is truly a remarkable time in the history of the education system in Afghanistan.

When Jim is not writing his thesis, teaching five classes, assisting students, or preparing presentations; he is juggling, urban spelunking, making polyhedra models, or card counting and always looking for cheap tickets to travel abroad. He can be reached at jugglinjim@hotmail.com

K–12 Mathematics Education: How Much Common Ground Is There?

By Anthony Ralston

In the August/September 2005 issue of FOCUS there was a brief summary [1] of a document entitled "Finding Common Ground in K-12 Mathematcs Education" (hereafter CG), whose full text may be found at http://www.maa.org/common-ground [2]. The authors of CG are two research mathematicians, three mathematics educators and the convener of the group, who is a senior vice-president and math and science policy advisor for a major American technology corporation and who has a Ph.D in applied mathematics.

There has been much controversy about American school mathematics in, at least, the past 15 years. The players have been, roughly speaking, the research mathematics community on one side, and the mathematics education community on the other. Thus, trying to find common ground between these two communities would appear to be a valuable exercise. And, indeed, much that is in CG will seem unexceptionable to almost all readers of FOCUS. But creating a document of consensus among six individuals who represent various points of view on the matter being discussed is fraught with difficulties.

One difficulty is that the attempt to be unexceptionable too easily results in blandness. Another is that, although the authors have certainly wished to avoid ambiguity, they have not always succeeded. A final difficulty is that when, occasionally, there is a definite recommendation, a group of six — *any* six — is just not enough to assure that there will not be significant disagreement in the communities they are addressing. The authors of CG have not avoided these pitfalls.

There is no need to say much about the blandness of some of the statements in CG since it is inevitable that there will be some in a document like this. But statements like "All students must have a solid grounding in mathematics to function effectively in today's world," "Students must be able to formulate and solve problems," and "Teaching mathematics effectively depends on a solid understanding of the material" would perhaps better have been omitted or, preceded by "Since," they could have been in each case attached to the sentence that follows.

I am sure the authors of CG strove mightily to avoid ambiguity. Here are two examples when I think they have not succeeded (at least for me).

(i) "Certain procedures and algorithms in mathematics are so basic and have such wide application that they should be practiced to the point of automaticity." But, without examples, what can this mean? The only example given is this one: "Computational fluency in whole number arithmetic is vital." What other procedures and algorithms, if any, should be automatic? And what about "computational fluency in whole number arithmetic?" Does this mean, for example, that students should be expected to be fluent with the traditional algorithm for long division? At most a small fraction of students have ever become "fluent" with this algorithm. And with calculators so easily available, what expectation can there be that more than a small fraction of students will become fluent in the future? And why just "whole number arithmetic?" Is arithmetic with decimal numbers less important than whole number arithmetic? Certainly not in the workplace.

(ii) "Calculators can have a useful role even in the lower grades, but they must be used carefully, so as not to impede the acquisition of fluency of basic facts and computational procedures." Since some of the authors have in the past opposed any use of calculators in K–6, this is a step forward. But what is the second portion ("but …") supposed to imply? If only that calculators should not be used mindlessly or for one-digit arithmetic, then this is a triviality not worth saying. If something more than this, then what? One suspects that, in order to accede to the first portion of this sentence, some of the authors insisted on the ambiguous second portion. This is a standard problem with consensus documents.

Some of the above might be viewed as mere quibbling although I think it is more than this. In any case, the examples below are of issues that will surely elicit disagreement with CG among a substantial number of readers of FOCUS.

(i) "By the time they leave high school, a majority of students should have studied calculus." Leave aside the fact that this— or anything close to it — cannot be achieved in any foreseeable future. Leave aside also the fact that many students who now study calculus in high school come away from it with little understanding and little more than an ability to perform mechanically various algorithms, all of which can be done better on a calculator. But, anyhow, why would you wish half the students to have studied calculus? Too much of the mathematics community has failed to come to terms with the fact that discrete mathematics is (almost?) as good an entrée to college mathematics as calculus. Not to recognize this in a document such as this is to arouse the suspicion that too many of the authors are living in the past. If they had said "…a majority of students should have studied first year college mathematics," that would at least have been a defensible aspiration. I would still not have agreed with it on the grounds of unattainability but, at least, the document would have sounded like it had had input from some younger mathematicians.

(ii) "Students should be able to use the basic algorithms of whole number arithmetic fluently, and they should understand how and why the algorithms work." This statement, no doubt, is to forestall people like me who have advocated abandoning traditional instruction in paper-and-pencil arithmetic [3]. But it sounds like voices from another century (the 20th!) to expect that most students will become fluent in the traditional algorithms when it is obvious that, outside of school, many (almost all?) students

will use calculators to do their arithmetic homework, no matter how much their teachers inveigh against it. And is there any chance that a significant number of students will "understand how and why the algorithms work?"

(iii) "The arithmetic of fractions is important as a foundation for algebra." Many of you may think this statement is innocuous but I don't. No one doubts that any non-trivial study of algebra must involve arithmetic with algebraic fractions. But while students should learn about reciprocals and the conversion of fractions to decimals and vice versa before college, it does not follow that prior study of the *arithmetic* of numerical fractions, even if still remembered by the time algebra is studied, is a good or necessary prelude to this. Indeed, the addition, subtraction and, particularly, the division of algebraic fractions [4] is rather easier than the same operations for numerical fractions. So what if students come to algebra without knowing the arithmetic of numerical fractions? Just teach it as part of the algebra course. Not only are the algorithms generally easier but the more mature high school students will learn them more rapidly than middle school students. Then, if you wish, apply the algebraic algorithms to numbers.

It is, I believe, almost surely futile at this time to attempt to find significant agreement between the research mathematics and mathematics education communities on the major issues confronting American school mathematics education. The disagreements on various matters — curriculum and technology being perhaps the most profound and obvious — are just too deep at this time to allow any non-trivial consensus.

Before such consensus can be reasonably attempted there will have to be, at least, a level of respect in both communities for the other that will mean that inevitable disagreements need not erupt into shouting matches. The CG document evinces such respect but it is far from universal among research mathematicians or mathematics educators. Mathematics educators must accept that professional mathematicians, research and otherwise, through their experience and insights, have the potential to offer much to school mathematics education. Research mathematicians need to understand that college and university mathematics educators generally, as well as many secondary school mathematics teachers, know and understand school mathematics. And research mathematicians will have to accept that the mathematics education community generally knows considerably more than they do about appropriate pedagogy for school mathematics.

Tony Ralston, who currently lives in London, is Professor Emeritus of Computer Science and Mathematics at SUNY at Buffalo. He has been interested in mathematics education for many years.

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Infinity and Beyond – A Mathematics Class for Life Long Learning

By Brigitte Lahme and Elaine McDonald, Sonoma State University

When was the last time you taught (or took) a course where you only covered topics that really interested you?; you had fun at every class meeting?; the students enjoyed every minute of the course and couldn't wait for the next meeting?; every day a lively discussion broke out and your students laughed at all your jokes?

Well, for seven members of the Sonoma State University's Mathematics Department this dream was realized in the Fall 2003 semester. We collaborated to create a new course titled "Infinity and Beyond" for the Osher Lifelong Learning Institute (LLI) — now in its fourth year at SSU. The Osher LLI exists on many campuses nationwide. It is for people over 50 who wish to continue their education just for the pleasure of learning and without the pressure of taking tests, writing papers or earning grades. Typical course offerings on our campus range from history ("Rethinking the Holocaust"), literature ("Mexican Women Writers") to current issues in the news ("America in the World"). But how often is a mathematics course offered? After surveying other programs it appears that ours is one of very few in the nation.

How do you design a successful mathematics course for the LLI program? Our challenge was to construct a course with topics that were appealing, beautiful, and touched on deep mathematical ideas without prerequisites and without building a foundation of basic skills. We wanted to share our love of mathematics with a community with widely varied mathematical background that may never have been exposed to mathematics beyond algebra or even arithmetic. And indeed, as it turned out, our class included retired engineers and mathematics teachers along with people who had had terrible experiences with mathematics as teenagers 60 years ago.

We chose *Infinity* as the theme of the course. Infinity has always fascinated people of all ages, and it is sure to spark a lively discussion. Concepts most closely related to our chosen theme included fractals, different magnitudes of infinity, convergent and divergent series, continuous probability distributions, Mersenne primes, and perfect numbers. Applications included encryption, quantities of drugs in the body under repeated dosing, and even protein folding, so at times we stretched a little beyond infinity, thus the title of our class became "Infinity and Beyond: The Beauty of Mathematics."

Each class period featured presentations by two or three of us. Topics for a given day were all closely related and intended to stand on their own. Our presentations did not involve detailed calculations or knowledge from prerequisite classes. Proofs that were presented could be understood visually or through analogy.

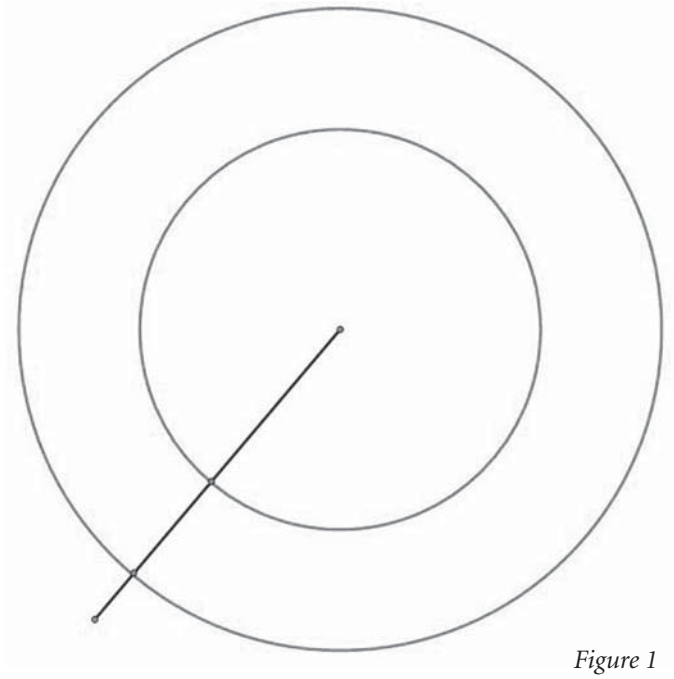

Figure 1

One of the first topics we discussed was the different sizes of infinity. We presented the diagram in Figure 1, which formed

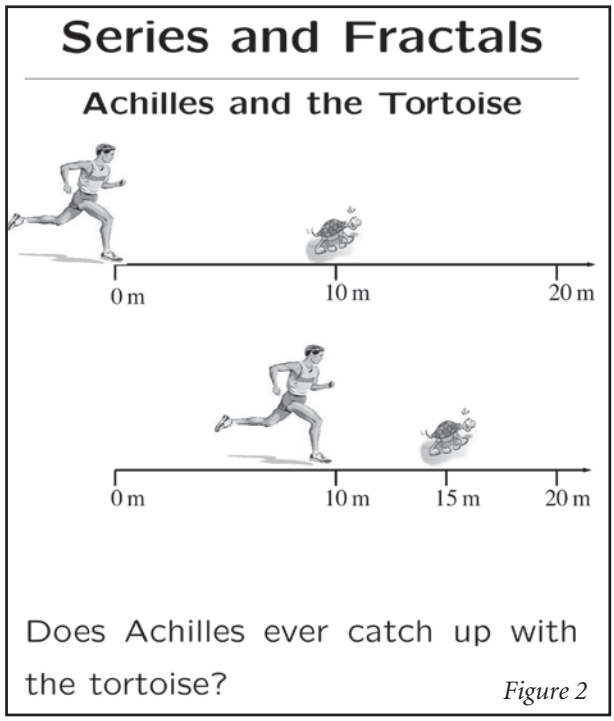

Figure 2

the basis of the medieval and Renaissance paradox studied by Duns Scotus and Galileo: One can form a 1-1 correspondence between each point on the inner circle and a point on the outer circle by relating the 2 points on the same radius. How, then, can the inner circle have as many points as the outer yet have an obviously shorter circumference? This brought up the question of how to measure and compare the sizes of infinite sets, and our exploration continued towards the idea of 1-1 correspondence and cardinality.
To introduce the idea of convergence of infinite series, we talked about Zeno's paradox (see Figure 2), which sparked a lively discussion on who will win the race between Achilles and the Tortoise.

This discussion led us toward the question: How can it be possible to add infinitely many positive numbers and not get infinity? We convinced our audience with the picture proof given in Figure 3, showing that the geometric series $\sum_{n=0}^{\infty}(\frac{1}{2})^n$ converges.

After everybody was happy with the proof, we proceeded to demonstrate by contrast that the harmonic series diverges using an analogy with record-breaking rainfall years. (See John Webb's article, "In Perfect Harmony," at http://plus.maths.org/issue12/features/harmonic/index-gifd.html). This raised a lot of protest, a lot of arguing back and forth and across the room, and we would still be talking about it had the class not ended. These students did not just believe what we told them, and we were quite exhilarated to look over a group of 40 students all closely following and quite comfortably challenging us with questions.

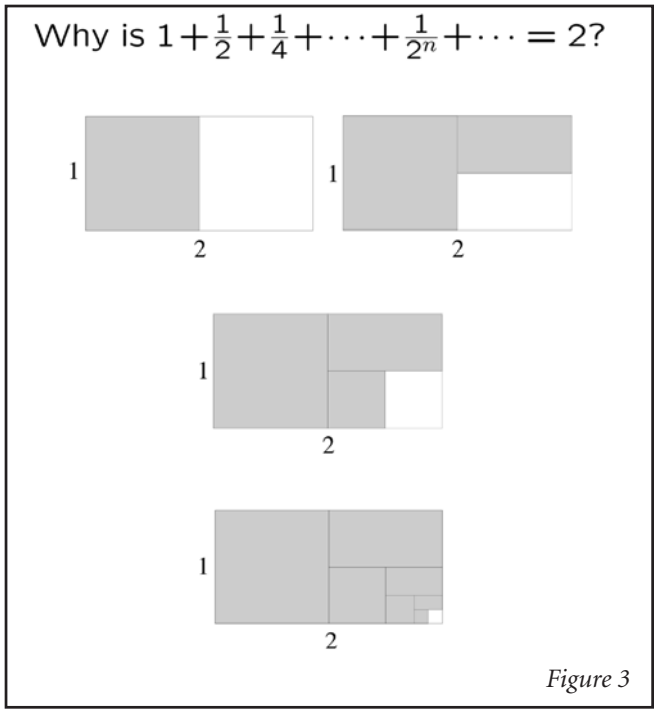

Figure 3

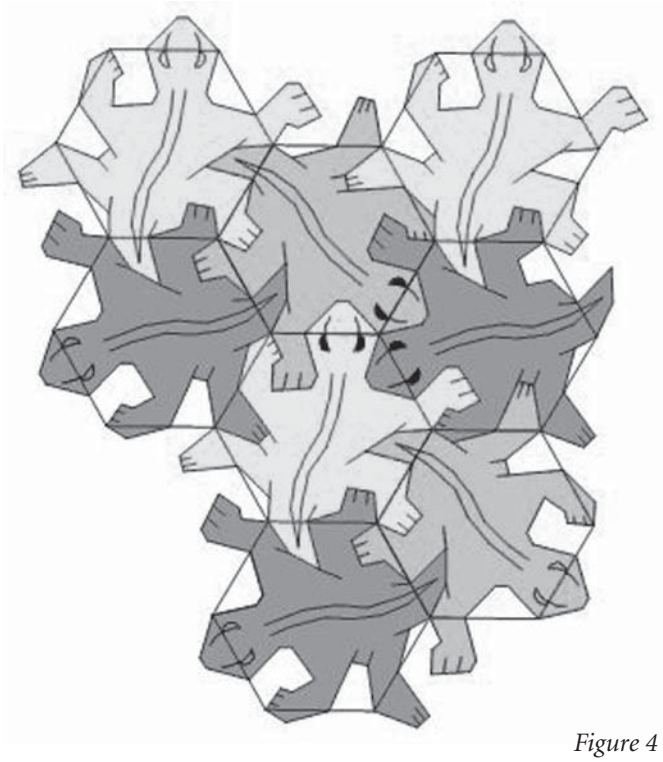
Figure 4

We used mathematical software as an aide when appropriate. Geometer's Sketchpad was used to give a construction of the Koch snowflake and to reveal the symmetry behind Escher's tessellations. (See Figure 4). The students appreciated the visual aids and were delighted to learn how mathematics and art connect.

Mathematica gave convincing demonstrations of the public key RSA cryptosystem. The computations involved in cryptography can get quite tedious and unwieldy, but a carefully prepared *Mathematica* notebook helped to walk the students through the theory behind the RSA cryptosystem and illustrate the methods with examples..

Many of the topics were put into historical context by our math historian and every day started with a quote about mathematics such as the one below:

The mathematician plays a game in which he himself invents the rules while the physicist plays a game in which the rules are provided by Nature, but as time goes on it becomes increasingly evident that the rules which the mathematician finds interesting are the same as those which Nature has chosen. — P. A. M. Dirac

We had a lot of fun teaching the course, but did our students like it? Surveys of the students done by LLI and by us were overwhelmingly positive. In large percentages students would

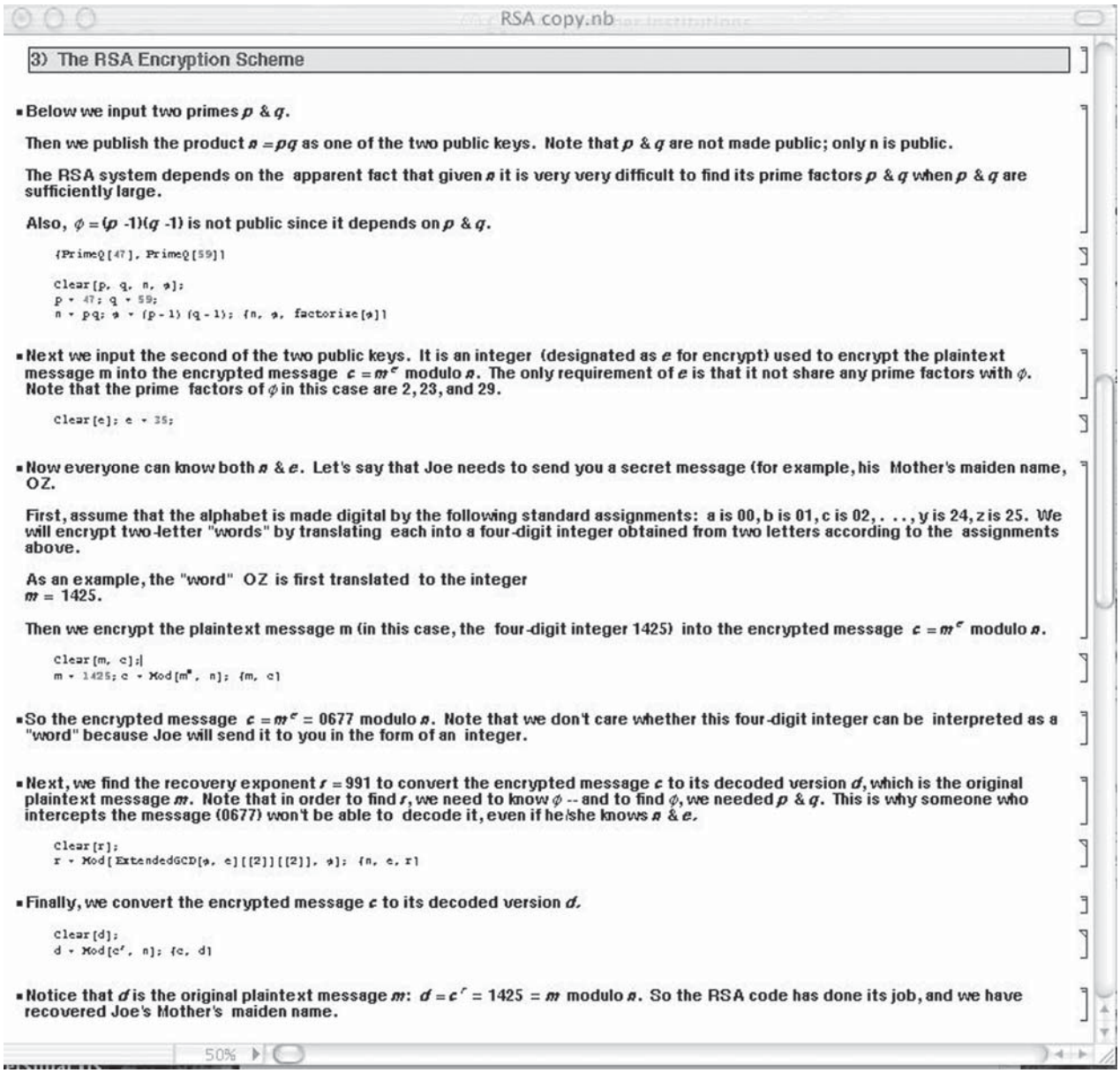

Figure 5

sign up for another Life Long Learning Institute mathematics class, felt the level was appropriate, and said their view of mathematics is now more positive as a result of taking the class. They also liked the enthusiasm, the variety and teamwork of the instructors, the sense of humor, openness to questions, and patience shown, and "The delight in math that instructors showed."

The mathematicians in our group have widely ranging interests. Bill Barnier, the group organizer, is a topologist. Edie Mendez is a mathematics historian and mathematics educator. Three other members of our group who also have interests in mathematics education are Sam Brannen, who is a geometer, Brigitte Lahme, who works with applications of symmetry in dynamical systems, and Ben Ford, who works in group representation theory. Elaine McDonald is a probabilist, and Brian Jersky, Chair of the Mathematics Department, is a statistician. It was stimulating to learn from each other and to prepare material outside of our usual spheres of interest. In addition, we collectively contributed the money that we earned teaching the course to our Math Support Fund and a Math Faculty Development Fund.

I believe it's safe to say that we all spent much more time on the course than we had anticipated, but thoroughly appreciated the experience. Students mentioned specifically that they enjoyed "The fun of doing math." And they were right, we had fun teaching this class, and we are already thinking about a sequel.

Brigitte Lahme and Elaine McDonald teach at Sonoma State University

Embry Riddle Celebrates Women in Mathematics Day

By Nirmal Devi

The Department of Mathematics of Embry Riddle Aeronautical University in Daytona Beach, Florida, celebrated the Women in Mathematics Day on May 13th, 2005. Approximately forty young high school women from area high schools participated in the event. The activities included talks by three female professionals, mathematical games, quiz competitions, workshop presentations for teachers, lunch, and the award ceremony. This event was planned by four female faculty members in the department.

Our first speaker was Ms. Queen Morse. She is a spacecraft test and launch engineer from Northrop Grumman Space Technology. She spoke on "The Space Shuttle Return to Flight Mission." Our second speaker was Ms. Astrid Heard. She is a retired Senior Statistician from John F. Kennedy Space Center. She spoke on "My Experience in Mathematics and with NASA." Dr. Katrina Palmer was our third speaker. She is from the department of mathematics at Appalachian State University in North Carolina. Her topic was "My Journey into the Land of Mathematics." The high school students asked these speakers many questions during their talks. From their questions one could easily see the interest of these students in the topics of discussion.

We also organized games and quiz competitions for the participating students. The students enjoyed competing, tried hard to win, and left with the feeling that mathematics can be fun. We gave prizes to the winners of the games and quizzes, which both the students and their teachers appreciated.

Just two days before the event, on May 11th, ABC news had declared that more than 6000 scientists, engineers and other experts urged Congress to increase opportunities for women to pursue careers in Science, Technology, Engineering and Mathematics. According to the US Labor Department, while women make up 46% of the overall workforce, they represent merely 10% of the engineers and 29% of the Computer Scientists and Mathematicians. One way to close this gender gap is to make the young high school female students aware of the opportunities before they make their career decisions. We felt that our event was a contribution towards achieving this goal.

Women in Mathematics day got some attention in the local media, including reports on the evening news and the *Daytona Beach News*, which published articles entitled "Women Plus Math Equal Success" and "MATH: Embry-Riddle Program Sparks Interest in Math." This type of publicity is welcomed by the university, which is primarily an engineering school and whose female population is only 17%. Since this event was very successful, the department of mathematics intends to hold Mathematics Day every year.

Nirmal Devi is Professor of Mathematics in the Department of Mathematics at Embry Riddle Aeronautical University, Daytona Beach, Florida.

In Memoriam

Janet Andersen, 47, professor of mathematics at Hope College died in an automobile accident on November 24 in Michigan. A very active member of the Association, she ran PREP workshops, was a speaker for Project NExT, worked on several MAA committees, and was co-author of the recent MAA book, *Understanding Our Quantitative World*. Memorial gifts may be given to the Hope College Department of Mathematics Scholarship Fund in memory of Janet Andersen. More information can be found in a Hope College press release, online at http://www.hope.edu/pr/pressreleases/content/view/full/7722 .

David Pingree, longtime Professor of History of Mathematics and Classics at Brown University, died on November 11. He had joined the History of Mathematics Department at Brown in 1971, served as its Chair since the mid-1980s, and later was its sole regular faculty member. During that time, he supervised approximately ten doctoral students. He had planned to retire at the end of the 2005/2006 academic year. Pingree was a leading scholar of the history of exact science (including mathematics, astronomy, astrology, and magic) in the ancient world. His many books and articles are very influential, and the quality of his scholarship was recognized by many academic honors, including a MacArthur Fellowship. Pingree's death raised worries about the future of Brown's History of Mathematics department, which was created in the late 1940s and is the only American research center focused exclusively on the study of ancient science and mathematics. (See, for example, the article in *Inside Higher Ed*, online at http://www.insidehighered.com/news/2005/11/15/histmath.)

Have You Moved?

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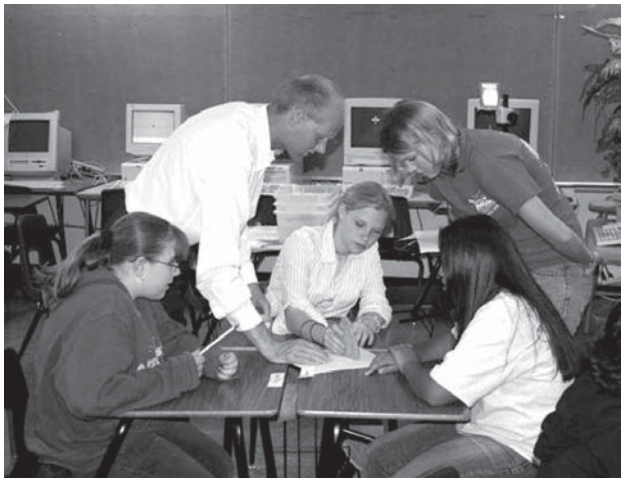
What We Learned... Creating Middle School Girls Mathematics Clubs

By Rachel Cline, Jerry Dwyer, and Traci Mclemore Salinas

Six girls chatted about their day as they shared cookies in the classroom, anxiously awaiting the mathematics project that their club leader was about to propose. The club leader, an undergraduate student from a nearby university, explained that the students would be constructing Rube Goldberg machines, the infamously complicated inventions that make the simplest tasks in life more difficult. After offering an example of the machine from a popular television cartoon, the club leader encouraged the girls to plan a Rube Goldberg machine that they themselves could later create.



Mathematics professor Jerry Dwyer and service learning student Natalie Williams guide the construction of a topographic model at the girls' math club in Atkins Junior High School in Lubbock, Texas.

One girl looked up hesitantly. "Us? As in *these* people?" she asked incredulously with a wave of her hand. The club leader nodded, and the wide-eyed girls began to plan. Two girls took the lead in deciding what task the machine should complete while one grabbed her notebook to draw. The others chatted about what sorts of materials were possible to use.

"We should make it pop a balloon," one suggested, while another added that the machine should pop a water balloon over their heads. Ideas to open a pizza box or launch a toy car across the room were discussed and dismissed quickly. The machine to pop a balloon was selected, and the girls started on their plan. They estimated the length of cardboard paper towel holders for a ram, the weight of a toy car to act as a balance, and the force needed to pop a balloon with a needle. As they worked, they began to talk with more seriousness and with encouragement for one another. "It's a good idea. It just needs a little work," commented one of the girls after a suggestion that was not feasible.

For an hour, these students worked together to solve the problem and to plan their Rube Goldberg machine. While their friends had already left school for the afternoon to watch television or to chat on the phone, these middle school girls remained after school voluntarily to work on mathematics. What would entice a middle school girl to spend time in the classroom for mathematics? How might this endeavor be replicated in other locations?

Middle School Girls and Mathematics

Historically, girls have been viewed as less likely to succeed in or to enjoy mathematics or the sciences. However, research has demonstrated that this is not because of a lack of ability. In fact, until middle school, girls score as well as their male classmates in mathematics. At that age, however, girls seem to fall prey to sex-role stereotypes and to pressures that often result in loss of self-esteem.

Thus the idea for middle-school mathematics clubs for girls aimed to capture and sustain their interest in mathematics at a time when they may be most vulnerable to negative feelings toward the subject. The philosophy was that if girls had a safe environment in which to experiment with mathematical ideas and enjoy success with them, they might develop more positive attitudes toward mathematics and be more likely to take more advanced mathematics courses in the future.

A Middle School Mathematics Club

Having received funding from the Mathematical Association of America TENSOR grant program, Jerry Dwyer, an outreach mathematician at the University of Tennessee, set out to create interactive clubs for middle school girls.

Three area middle schools agreed to host the clubs, each providing a mathematics teacher as a club sponsor. The university provided a female club leader (and role model) for each school, selecting leaders from among its mathematics graduate and undergraduate students. Two faculty mentors from the university provided resources for activities and coordinated the activities of the clubs. Clubs met once a week after school for about an hour. Frequently pizza or other snacks were provided as the girls worked on mathematics problems or engaged in problem-solving activities. Two large projects, designing t-shirts and creating Rube Goldberg machines, were used at all three schools.

Dwyer moved to Texas Tech University in 2003 and obtained further MAA/Tensor support to develop math clubs in Lubbock, Texas. Now six clubs are in operation there. The mathematics clubs were viewed as great successes in all schools, and teachers and administrators from other schools inquired about starting their own similar clubs.

With such a positive response, the club sponsors determined to share the knowledge gained from their experiences with creating and sustaining the middle school mathematics clubs.

What We Learned

1. **Understand the school and social calendar of your students.** Attendance at the

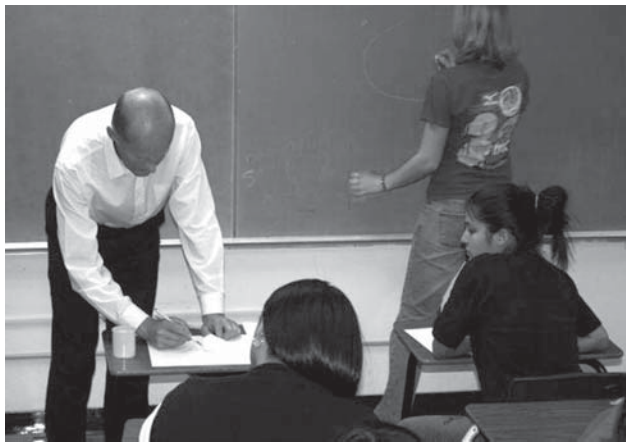
club meetings will vary, sometimes dramatically, during the year. As spring soccer time arrived, club leaders noted that fewer students participated in the club meetings. Other sporting events and even family vacations caused the spring attendance to be much different from the fall attendance. Although these conflicts cannot be avoided, staying informed of the events at the participating school can guide leaders to choose club meeting days that are convenient for all students. Furthermore, some schools offer club meeting times during the day that could offer an alternative to after-school times.

2. **Serve pizza!** Our club leaders noted that students interacted more effectively when gathering around food. Pizza or other snacks were often offered as an enticement to attend the meetings, but snacks also ensured some initial quiet time in which to explain the activities for the day.

3. **Select charismatic young club leaders.** Students responded well to club leaders who were energetic and enthusiastic. These leaders were better able to keep the students engaged during meetings and to maintain interest in the clubs. Furthermore, students tended to identify more with club leaders whose age was nearer their own.

4. **Stay in touch with your sponsoring teachers.** Sponsoring teachers are happy to explain what material is in the school's curriculum as well as which topics students are currently studying. Very often, sponsoring teachers can also suggest specific skills on which students should practice and will provide feedback on students' progress in mathematics classes. Sponsoring teachers can also help navigate discipline issues, the school calendar, and club policies, leaving club leaders to focus on creating and leading activities.

5. **Encourage club leaders to introduce resources that demonstrate the role women have played in mathematics and the sciences.** With class time often dedicated to skills and practice, little time is afforded to investigate mathematics history. Consequently, students are unaware of the contributions made to the field of mathematics by women and minorities. Taking time to introduce some of these personalities provides examples of female mathematicians for students. Furthermore, visits by working mathematicians and scientists can provide role models for young students.



From contours on the blackboard to three dimensional shapes on the table.

6. **Provide activities that draw the girls together.** Middle school is difficult enough socially for students without creating activities that separate. The mathematics clubs offer an opportunity to have students from various classes and cliques work together. Thus, group activities should be utilized, and club leaders can ensure that the composition of groups changes regularly. The creation of club t-shirts allows students to show their unity as a club; wearing the shirts on club meeting day visually connects the members with one another.

7. **Have activities that produce tangible results.** Although engaging in problem-solving activities is rewarding enough for most students, some will require more tangible results in order to recognize their own success. T-shirts and Rube Goldberg machines are two examples of activities in which students actually create something to show for their efforts.

8. **Model mathematics as a creative endeavor.** Club leaders discovered that students tended to think of mathematics as a stagnant, procedure-driven subject. They often failed to recognize the link between mathematics and the creativity involved in problem-solving. Hence, showing students that mathematics is dynamic and mentally engaging is essential to maintaining interest in the subject and, hopefully, in a career in mathematics. Modeling mathematics as creative is as simple as selecting interesting problem-solving activities, using a variety of manipulatives and other materials, and demonstrating that mathematics is not simply a procedure-oriented field.

9. **Plan, plan, plan.** The most important step in starting successful mathematics clubs is to plan carefully. This includes planning in conjunction with sponsoring school schedules and planning inviting activities. In addition, however, club leaders and sponsors may also find it necessary to plan ahead for evaluation or publicity. Knowing school policies for student and parent permissions for evaluation and photography are essential to avoid difficulties later in the process.

A middle school mathematics club for girls provides an enjoyable and safe environment in which students can experiment with mathematics. Students may develop more positive attitudes toward mathematics and consider mathematics as a possible career field in the future. We move closer to the National Council of Teachers of Mathematics goal of "Math for All."

Jerry Dwyer is assistant professor (and outreach mathematician) in the Department of Mathematics and Statistics at Texas Tech University. Rachel Cline is a graduate student at Texas Tech. Tracie Mclemore Salinas is assistant professor of mathematics education at Appalachian State University.

On Boiling Hot Seas and Pigs with Wings... A Philosophy of Administration

By Larry Bouldin

When I was an undergraduate student, I was in awe of the Dean of the college. He was a very dignified gentleman who wore nice clothes, was gracious and witty and charming, and who seemed always to be calm and in control. He had a wonderful office, filled with lovely antiques, which served as a quiet oasis on campus. He was known by all, and he seemed in turn to know everybody. The faculty admired him and he was always quick to praise them. He was a scholar and a gentleman. Not very many years after my graduation, though, he was no longer Dean. His scholarly approach to leadership had been displaced by a much more pragmatic one.

I was a faculty member at Roane State for 30 years before taking on the job of Dean of Math and Science. We were a fairly congenial group without any major disagreements… or so I thought. Upon hearing horror stories of other places that were rife with turf wars and bitter sniping between rival camps, I was grateful for our group. So upon becoming Dean, I had illusions of an existence like the Dean of my undergraduate days… nice clothes, nice office, quiet contemplation.

During my first week as Dean I had to deal with: a contingent of angry students bitterly complaining about a faculty member; a disgruntled staff member filing grievances against everyone in sight; faculty complaining about this disgruntled staff member; parents calling to complain about the bookstore; a controversial tenure denial; faculty evaluation reports and both summer and fall schedules being due immediately; budget hearings looming on the horizon; some faculty complaining about their teaching loads; and finally an adjunct who disappeared one Friday afternoon and did not reappear (at least there was no foul play involved).

I hit the ground running and haven't stopped since. I deal daily with the teachers of biology, chemistry, mathematics, physics, astronomy, engineering, and geology… some of them prima donnas and others who just want to be let alone. Quickly recognizing that I would be around for long days, I moved into my office some of my favorite antiques and paintings and a good coffeemaker. I learned to prioritize and delegate to good people. I found out very soon that a good secretary can make or break you. I discovered that everyone's problem or request was of the utmost urgency and demanded immediate answers. I learned to say, "I'll get back to you on that," and I would… later. I also learned that no one ever died from an educational emergency. I profit from having a patient and understanding supervisor and mentor. Occasionally, I do get to sit on my office sofa and read and ponder, but not often. I still have to put out brushfires and herd cats… and I really do like this job.

At the same time, I attempt to be inclusive, supportive and encouraging to faculty and staff, and for the most part, they respond well. At the beginning of each semester, I host a brunch with good food, nice decorations, and small gifts for them. We share good news first; then mention other things that are in the works for the semester. I am quick to communicate with emails and take every opportunity to thank folks and congratulate work done well. I am accessible and willing to listen. We now have a Commons Room where I often have refreshments and good coffee available. I stress that I appreciate their differences and unique qualities, but let them know that we need to work together for the greater good. I keep my word and people know where I stand. The work does get done well and on time. My division and others regard our operations as stable, smooth-running and managed competently.

I still have a lot to learn. I still dislike the budget process here: it remains a mystical and inexplicable thing with never enough money to go around. I fight for what spare change there is and encourage faculty to be as creative as they can. I push professional development and do my best to get faculty involved with innovative teaching methods, while at the same time respecting those who teach well using traditional means. I support other divisions and sites by coordinating the offering of courses they need at the times they need them, and I always, always uphold high academic expectations and standards.

There are several standing curriculum committees within the division that are given the freedom to choose texts, materials, content, scheduling and I stand back and do not second guess. However, I do not hesitate to let them know if I have a strong opinion regarding the benefits to the whole group. I like consensus, but if need be, I can make a decision. Major initiatives have seemed to come from levels above me and our task so far has been to implement them efficiently, and we have done so.

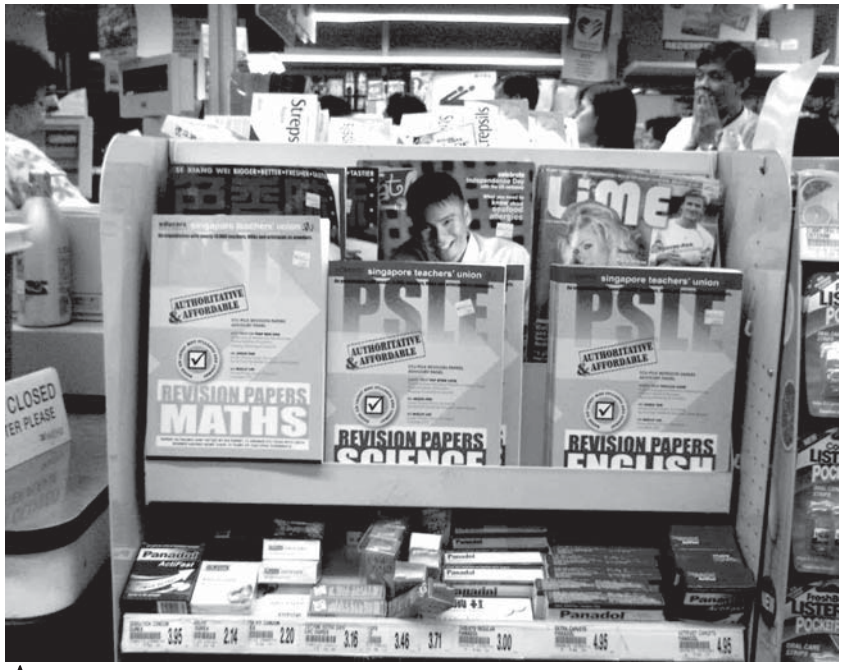
One of the real joys I have encountered is hiring new faculty, which I regard as my legacy for the school. While I may not be an expert in a particular field, I would hope that I am humble enough to recognize those who are. I value scholarship, but also believe in good teaching. There is no excuse for shoddy work in either. There should not be an attitude that one area of expertise or interest is somehow more worthy than another. We are not in competition, but are complementing one another. In many cases, a reputation for good teaching can be as valuable as published research. Bad teaching can often diminish the department or division in the eyes of the public and hinder any outreach program or recruitment of students. Both faculty and administrators must remain accessible and engaged in this endeavor we call Higher Education.

I still wear bow ties and tweed jackets and do my best to emulate the Dean of my

memory, but now have a much more realistic attitude towards this job of administrator. I realize that I must advocate for the faculty at the same time I try to explain the "ways of god to man" by conveying to them the decisions made by others… decisions often motivated by politics or agendas not our own. Some days we fail, but we keep on trying. The MAA workshop dealing with being a department chair was one of the most helpful things to come my way. I was told on several occasions by others that the "shelf-life" for this type of job is five years, but I try not to worry. I try to maintain a sense of humor and optimism, of idealism tempered with realism, and keep faith that good intentions and hard work really do pay off in the long run… and yes, I find that this sea that is navigated often is boiling hot and a pig just may have wings after all. At least the little iron one on my desk does.

Larry Bouldin is Dean of Math and Science at Roane State Community College in Harriman, TN. He is also Professor of Mathematics. This article is a companion piece to one that appeared in the March 2005 issue, "Of Cabbages and Kings…A Philosophy of Teaching." He hopes that, wherever he might be, Lewis Carroll doesn't mind the use of his phrases too much.

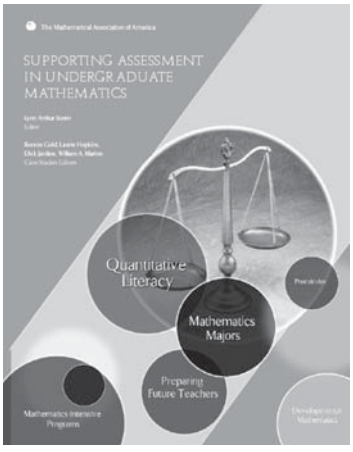
Singapore: Math at the Checkout Counter



As happens everywhere else, supermarkets in Singapore try to get you to make a last minute purchase. But while in the US they tempt you with the *National Enquirer*, in Singapore they try to sell you math books! The book is a study guide for the PSLE (Primary School Leaving Exam), published by the Singapore Teachers Union.

By the way, when was the last time math text books in the US were advertised as being "Authoritative and Affordable"?

(Photo and comments by Helmer Aslaksen of the National University of Singapore; used with permission.)



A special section in the November issue of FOCUS featured materials developed through MAA's Supporting Assessment in Undergraduate Mathematics project (SAUM). The eponymous project report is now available and provides articles that provide an overview of some of the challenges and opportunities for improving student learning through effective assessment. Case studies from institutions who participated in the project offer snapshots of projects at institutions seeking to assess single courses, blocks of courses or entire programs. Designed to serve as a resource for departments developing their own assessment plans, a complimentary copy of the new SAUM report is available to the first 1000 departments submitting requests through the project website http://www.maa.org/saum, where you can also access the full text of the report.

The Math Club at Madison Area Technical College

By John Rosenberg

Since its founding in 2000 with the help of a new faculty member, Jeganathan Srikandarajah, the Math Club at Madison Area Technical College (in Madison, Wisconsin) has become one of its most active organizations. In addition to sponsoring study sessions with faculty to prepare MATC students for regional and national competitions, the club has organized several middle and high school contests bringing together younger students for lectures, games, and tests.

Monthly talks by invited speakers are well-attended by students and staff and are taped for later viewing for those who cannot come. Discussions often continue as refreshments are served after the lectures. In the spring of 2006 the club will celebrate the fiftieth such talk featuring accomplished mathematicians from other institutions. Among the intriguing titles for talks were: "Dirty Children, Unfaithful Husbands," "The Famous Monkey, Sailors, and Coconuts Problem," "Do Dogs Know Calculus?," "Choosing Your Ideal Companion," "Worms, Blocks, and Harmony," "Rainbows and Halos," and "The Case of Migrating Umbrellas."

Art work and a pie-eating contest highlight the annual PI Day (3/14) festivities, and the club has shown films like "A Beautiful Mind" and held book discussions (for example, of *Flatland*) to expand awareness of mathematics. MATC was one of a pair of sites chosen by the American Mathematical Society to host a "Who Wants to Be a Mathematician?" show that netted several Wisconsin high school math whizzes thousands of dollars worth of prizes and lots of fun. In subsequent years the club organized its own version of the program called "Who Wants to Be a Super Mathematician?" This year Madison East High School students performed a musical, "Fermat's Last Tango," as part of the Math Club's Math and Music Festival. For next spring's festival, Milwaukee Marquette High School will present "Math Morsels and Mayhem."

Promotional poster for the MATC math club Math and Music Festival.

Scene from the MATC math club production of *Fermat's Last Tango.*

The Math Club communicates with the public as well as its members by hosting a web site that features a schedule of upcoming events, pictures from recent activities, and challenging problems for visitors to explore. The link that serves as gateway to all these topics is http://matcmadison.edu/is/as/math/mathclub.

John Rosenberg is a mathematics instructor at the Madison Area Technical College in Madison, Wisconsin.

Solutions to Sudoku Puzzles

9	5	3	4	6	7	2	1	8
8	7	4	1	3	2	9	6	5
6	1	2	8	9	5	4	7	3
2	3	6	7	8	4	5	9	1
1	9	8	2	5	3	7	4	6
7	4	5	6	1	9	3	8	2
5	8	7	3	4	1	6	2	9
3	2	1	9	7	6	8	5	4
4	6	9	5	2	8	1	3	7

Solutions to Puzzle 1

9	3	4	5	7	1	6	8	2
7	2	8	4	6	3	5	1	9
1	5	6	8	2	9	7	3	4
8	7	9	1	5	4	2	6	3
6	4	5	2	3	8	9	7	1
2	1	3	6	9	7	4	5	8
5	8	2	3	4	6	1	9	7
4	9	1	7	8	5	3	2	6
3	6	7	9	1	2	8	4	5

Solutions to Puzzle 3

M	L	I	R	H	T	A	G	O
T	O	H	G	L	A	R	M	I
A	G	R	M	I	O	H	L	T
H	A	M	L	G	I	O	T	R
G	R	T	H	O	M	L	I	A
O	I	L	T	A	R	G	H	M
L	T	O	A	M	H	I	R	G
R	H	A	I	T	G	M	O	L
I	M	G	O	R	L	T	A	H

Solutions to Puzzle 3