

Mathesis

Volume 45, Issue 1

August 2012

Looking Forward to our 50th Anniversary Celebration

Thoughts and recollections about NH-ATMNE/NHTM

By Ferd Prevost

Upcoming Deadlines:

- September 14: Early Bird registration for Hartford NCTM Regional.
- September 25: MAA Contributed Paper Abstracts for 2013 Joint Mathematics Meetings
- October 30: Registration deadline for Dine and Discuss
- December 15: Prevost and Evans nominations due
- January 1: Nominations for Balomenos award due

It was on a bright, cool morning on April 4, 1964 that some 300 teachers gathered at St. Anselm College for what was advertised (quite optimistically some would say) as the “First Annual Meeting” of an association to be known as The New Hampshire Section of The Association of Teachers of Mathematics in New England, NH-ATMNE. (Later, as you know, that name was changed to New Hampshire Teachers of Mathematics, NHTM.)

Some of the highlights of that first meeting include the presence of Richard Pieters, then the President of E. Mass Section of ATMNE, who gave the closing address and was asked to greet the new section, should the attendees agree to form it; the willingness of Jack Adkins, of Phillips Exeter Academy and the Adkins of the “Weeks and Adkins” high school math series so popular at the time, to serve as the first President; and the enthusiastic endorsement of the Association by those present. In a brief business meeting, we were born, we petitioned to be accepted into the New England association, and we elected our first set of officers. The program was also well received and was key-noted by Clarence Bennett, Mathematics Supervisor in Brookline, MA.

This was the era of “New Math.” Bennett’s address was titled: “The Shaping of a Curriculum”
(Continued on page 10)

Inside this issue:

Art's Attic	2
President's Message	3
Post-Secondary Rep	4
Elementary Rep	5
Secondary Rep	6
Award Nominations	7
Dine and Discuss	8
Middle Level Rep	9
Across the Regions	12
Listserve Information	16
Membership	18

NHTM Mathesis to Go Green

By Terri Magnus, Editor

The Board of New Hampshire Teachers of Mathematics voted at their July meeting to move toward a paperless newsletter as early as November 2012. NHTM Members will receive an e-mail notification with a link to the new issue’s pdf file. It is anticipated that this new format will not only save paper, printing costs, and mailing costs, but will also enable members to receive the newsletter more quickly. Web and e-mail addresses will become active links. Editions of *Mathesis* will be posted on the NHTM website for future reference.

The Association of Teachers of Mathematics in New England also began sending its newsletter electronically this year. Members who did not receive the spring edition are encouraged to check that their e-mail addresses are current and their accounts have been set up to accept bulk messages from both NHTM and ATMNE. Contact the membership chair, Cecile Carlton, to update contact information.

Art's Attic: Stomachion

By Art Johnson

People are always compiling superlative lists of one sort or another; best NFL quarterbacks of all time, best supporting actors, best concert albums, and so forth. Mathematics historians generally agree that the three mathematicians of the first rank are Archimedes, Carl Freiderich Gauss, and Sir Isaac Newton. Naming the greatest among these three is another matter. You could make a case for any one of them. Certainly Newton showed the greatest burst of genius in a short period of time. When he fled Cambridge University in 1663 to escape the Plague, he was an obscure, unremarkable student. Once back at his country home he developed the laws of thermodynamics and universal gravitation, and invented calculus so he could accurately explore them. No one else has ever come done so much in so short a time. However, for mathematics stature across a lifetime, I vote for Archimedes. Here's why.

Most people are familiar with the story of Archimedes and the bath water, and his challenge that if he had a place to stand (and a long enough lever) he could move the earth. These principles (all mathematics based) along with other mathematics achievements have easily earned him the honor as the greatest mathematician of antiquity. I believe a recently translated manuscript of his writings, the *Archimedean Codex*, has moved him to the Greatest of All Time.

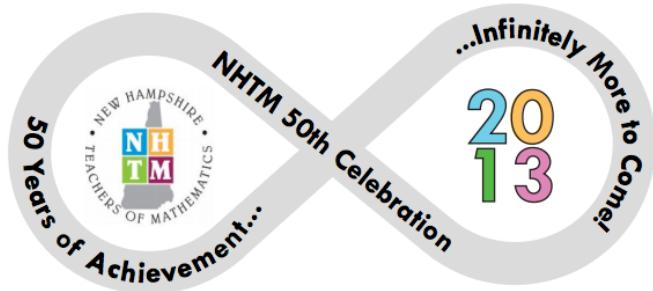
The Codex is a palimpsest. It contains copies of several previously unknown works by Archimedes, including a copy of a letter from Archimedes to Eratosthenes, that had been written on sheepskin. Some centuries later, in 1229, scribe Ioannes Myronas scraped down the surface so he could use the precious parchment to copy out prayers, hymnals, and other ecclesiastical works. To the naked eye the scribe obliterated most of Archimedes writings. Although what was visible had been translated a century ago, it remained

mostly undecipherable until modern digital tools unlocked its secrets. (This act of mathematics desecration actually saved these previously unknown works for modern times.)

After nearly nine centuries, and much deterioration, the Codex recently found its way to a public auction, where it was offered up as more of a curiosity than anything groundbreaking. Fortunately a private individual bought the Codex, and he bankrolled the subsequently painstaking work needed to read the entire manuscript (still ongoing). What mathematics historians found when they used spectrum imaging to read the barely legible writing in the badly decomposed manuscript is astounding.

It has long been thought that if Archimedes had access to modern notation then he would have developed the concept of infinity that is needed for calculus. One of Archimedes works in the Codex is *The Method*, where he makes the jump from finite numbers to infinity. In brief, he describes how to find the area under a parabolic curve. He method is to fill it with triangles and sum their areas. Of course, this leaves some small areas outside the triangles. Archimedes solution is to repeat the process with smaller triangles so that the remaining outside area is but 'the breadth of a hair'. Nevertheless, that hairsbreadth still needs to be included. So, Archimedes repeats the process, now getting down to an area only the width of an atom. Archime-

(Continued on page 14)



April 4-5, 2013, Manchester

President's Message

By Greg Superchi

Welcome back for the 2012-13 school year! I consider each year a brand new start for all: students, parents, teachers, and administrators alike. It is also a special new start for me as this is the beginning of my two-year term as NHTM President. It also marks the end of Judy Curran Buck's term as President and begins her one-year service as Past-President. I am so thankful to still have her help and guidance right at my fingertips! I want to commend her on her direction and guidance of the NHTM over the past two years. She is truly someone I consider a mentor and am honored to work with and learn from. She is among the finest mathematics educators/leaders/professionals in our state and region!

The NHTM is that place mathematics teachers can go to for help, guidance, and to improve themselves. As a pre-service mathematics teacher, I went to my first NHTM Spring Conference and fell in love right away! I could not believe the selection of workshops, quality of presentations, and the passion I saw from people just like all of you. As your president, I hope to continue NHTM's long-standing focus on providing professional development to NH teachers to help ensure quality mathematics instruction for all NH students. Although I am focused on NH mathematics teachers, my true passion and targets are the mathematics students of NH. I want to see that they have the highest quality mathematics education opportunity of any state in this country or region of the world. Do I think that is possible? Maybe it is, maybe it is not. However, we can sure try! As the famous quote says, "Shoot for the moon and if you miss, you will be among the stars."

While I am on the preparation of NH math students, I hope you had the opportunity to read the two letters delivered to the Commissioner of Education and the Chairman of the NH State Board of Education by Judy Curran Buck, Rich Andrusiak (thank you for writing the original draft), and me. The letters are in response to *The New Hampshire State Task Force on Mathematics Instruction – Report to the State Board of Education 2012*. The NHTM Executive Board voted unanimously to en-

dorse the first letter in which we commend the New Hampshire Department of Education for their commitment to addressing the themes and goals named in response to their study of curriculum and instruction in New Hampshire.

However, the Board strongly advocates for a change to *Recommendation #2* in order to meet the themes and goals stated in the report. The Board felt the Report was weak in that it recommended the continuation of 3 credits of high school mathematics and including algebra 1 proficiency. NHTM is calling for a stronger recommendation so that all students would be encouraged to take 4 years of high school mathematics and demonstrate proficiency through algebra 2 with a focus on communication, reasoning and sense making, and mathematical modeling. We believe this revised recommendation will align closer to the goals and objectives of the Common Core State Standards than the original recommendation found in the report.

The second letter is written by J. Michael Shaughnessy, President of the National Council of Teachers of Mathematics, in support of the NHTM Executive Board's position. What an honor it was to have him as the keynote speaker at our Spring Conference (kudos to Stephanie Wheeler for helping to bring him here!). If you would like copies of these letters, please send me an email at gsuperchi@yahoo.com. I hope these letters have gotten some good conversations going at all levels and will move forward the mathematics education of NH students.

Finally, thank you to all the NHTM Board members who give up a great deal of their time and resources. Their commitment and sacrifices often go without being seen. For instance, each one of them gave up a full day this summer to attend our annual summer retreat. Honestly, the only thing that makes it a retreat is the hour we take for lunch to have a cookout and enjoy the lake (thank you to Dick and Susan Evans for your hospitality)! I look forward to working with each of you on the Board and relying on your expertise over the next two years.

Post-Secondary Representative:

Focusing on Connections PK-16

By Rich Andrusiak

At the beginning of each academic year, I identify a mathematical theme to focus on in my classes. For the 2012-2013 academic year, I will focus on connections. Students who make strong connections will be able to bridge concrete and abstract ideas and deepen their understanding of mathematical ideas and concepts. As we concentrate on meeting content standards in a high-stakes environment, let's keep in mind the importance of guiding students to discover deep connections.

I recently had the opportunity to help teachers deepen their understanding of mathematics and focus on connections. During the summer, I co-taught a professional development course for K-8 teachers with our NHTM President, Greg Superchi. A session on linear models inspired not only the desired connections for the teacher participants but also deepened my own understanding of the connections between high school algebra and the field of Multivariable Calculus.

Teachers were engaged in examining student work on three mathematical tasks – a grade 2 item, grade 4 item, and grade 6 item. Teachers were able to connect the grade 4 and grade 6 tasks to linear patterns, but did not initially see a strong connection between the grade 2 item and linear patterns.

The grade 2 item asked how many different ways 12 objects could be separated into two groups. [I've adapted the item for illustration purposes. The original item was imbedded in a context and contained only 7 objects.] Teachers were excited to discover that additional number facts connect to linear patterns – many mentioned that they had never considered this before the discussion. We discussed thinking about two whole numbers that add to 12, or $\square + \Delta = 12$. We then created the following graph and discussed connections between verbal descriptions, tables, graphs, and symbolic representations.

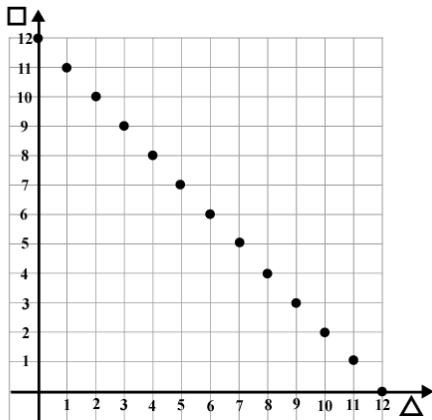
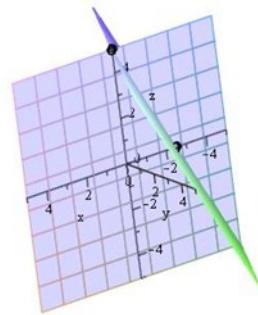
We ended this conversation thinking about multiplication facts and wondering what a graph would look like. Later that day, we discussed various forms of linear equations. Teachers worked through examples embedded in meaningful contexts that convinced them that linear equations can be written as $y = mx + b$ in symbolic form, where m represents the slope or rate of change and b represents the y -coordinate of the y -intercept. Once teachers were comfortable with the slope-intercept form, we discussed the point-slope form of a linear equation: Given a line with slope m and a point, (x, y) , on the

line, we asked how we could determine if a point (h, k) is on the line. Teachers discussed that (h, k) is on the line if

$$\frac{y - k}{x - h} = m$$

which leads to the point-slope form of a line, $y - k = m(x - h)$. We then made the connection between the point-slope form of the line and the slope-intercept form noting that $b = -mh + k$. On the way home (and while fly-fishing with Greg later that night – probably why he caught more fish than me), I reflected on the extension of linear functions

(continued on p. 13)



Elementary Representative

The Common Core State Standards (CCSS): The 8 Mathematical Practices

By Stephanie Wheeler

Teaching in this age of high stakes testing can be overwhelming and frustrating. However, when we are teaching to strong mathematical standards and using “best teaching practices,” it makes sense. Last year I was part of a PLC that “dissected” the 8 Mathematical Practices of the CCSS. The intent of the PLC was to look at each Practice and find a word or a phrase that encompassed the message of each Practice. We then brainstormed where in our math teaching we are putting the *“essence of the Practice”* into use, and how else we might incorporate the Practices into our math instruction. It generated some great discussion and I would highly recommend the process. I hope that sharing the notes from our PLC will help you begin a dialogue in your own PLC on the 8 Mathematical Practices. The outline below is the result of that process for our PLC:

Practice #1: Make sense of problems and persevere in solving them.

- **Persevere**

- ◊ You solved the problem by adding 5 twenty times; Your friend solved it by multiplying 5 by 20. Who is right? Whose method is more efficient? Turn and talk to your partner.
- ◊ Explain to your partner why your answer/ estimate makes sense.

Practice #2: Reason abstractly and quantitatively.

- **Deconstruct / Connect / Reconstruct**

- ◊ We need to help students make the connections!

- ◊ **Making Sense of the Abstract**

- ◊ **Reason**

We need to have students sharing their reasoning both orally and in written form.

Practice #3: Construct viable arguments and critique the reasoning of others.

- **Construct / Critique / Reason**

- ◊ Done through Cooperative Learning Activities
- ◊ **Analyze**
- ◊ Turn and Talk
- ◊ Math Journals
- ◊ Constructed Response

Practice #4: Model with Mathematics.

- **Model with Math**

- ◊ Make sure to give students enough time with manipulatives/pictures/ diagrams, etc. Students will move away from concrete models when they don’t need them anymore.

- **Global Interpretation and Application**

- ◊ Students often know $l * w = a$, but can they tell you how much carpet to order if they want to carpet their living room?

- ◊ Students can solve $3 + 2 = 5$, but can they tell you how much money you have if your brother gives you \$3 and your mom gives you \$2?

Practice #5: Use appropriate tools strategically.

- **Tools – Pencils to iPads – Technology**

- ◊ ALL students need concrete tools!

- ◊ Students need practice in determining when to use tools and which tool is best to use.

Practice #6: Attend to precision.

- **Communicate Precisely**

- **Use evidence to support your answer**

- ◊ Student: The answer is “6.” Teacher: “6 what?” The WHAT really matters!

- ◊ Specify, label, calculate and communicate

Practice #7: Look for and make use of structure.

- **Finding Patterns**

(Continued on page 14)

New Hampshire Teachers of Mathematics Dine & Discuss

The Dine & Discuss Mini-Conference provides a forum for educators to come together and explore a particular mathematical topic.

Fall 2012 Dine & Discuss

Common Core: A Focus on Standards for Mathematical Practice

Monday, November 5 from 4:30 p.m. until 7:45 p.m. at the Holiday Inn, 172 N. Main Street, in Concord, NH

The Fall 2012 Dine & Discuss will feature a keynote speaker followed by dinner and K-4, 5-8, and high school grade-level breakout explorations on the Mathematical Practices in the Common Core Standards. NHTM Board members will facilitate the grade-level breakout sessions.

Registration

Register early as seating may be limited.

Registration is due by October 30, 2012.

Registration is \$30/person for NHTM members and \$55/person for non-members (includes the option of membership).

Full-time undergraduate students – \$15/person.

To Register go to <http://tinyurl.com/d6fuzlq>.

For more information contact Rich Andrusiak at r.andrusiak@ccsnh.edu.

Middle Level Representative

Mathematical Share-a-thon

By Katrina Hall

Another year of planning has begun for math teachers. Teachers have started on their hunt for resources, ideas and tools to enrich and intrigue students. Wouldn't it be nice if you opened your email and up popped a series of mathematical supports?

Let's start the year off right. Below I have listed ten resources that I think every math teacher should be exposed to. Add them to your math toolbox and enjoy. Your task is to continue this share-a-thon. Take the time to write a quick email listing your ten mathematical resources and send it out to as many math teachers as you can (the more the merrier). Ask these teachers to then do the same. A little exponential growth would be a good thing.

Be creative and don't worry if your resources are not web based, books are a good thing too! Can't think of ten? That's okay. The idea of this mathematical share-a-thon is to support one another in this sometimes lonely field of teaching. Let's share the wealth we have stored in our file cabinets and join together to spread the joy of mathematics.

Katrina's Ten Mathematical Resources

1. **Mathalicious** (www.mathalicious.com) contains CCSS lessons which ask real questions in open-ended ways requiring students to problem solve and think critically.
2. **Yummy Math** (www.yummymath.com) provides teachers with real-life lessons to bring into their math classrooms. Concepts are explored that are interesting to students with the goal of increasing mathematical engagement, reasoning, critical thinking and communication.
3. **NRICH** (nrich.maths.org) is an online resource which offers free enrichment materials to help inspire and engage learners.
4. **Pinterest** (pinterest.com) is the latest crave in visual bookmarking. The teacher resources to be shared are too vast to name. Take the time to investigate this tool and you will truly be amazed at the resources readily available to you.
5. **Teaching Channel** (www.teachingchannel.org) is rich with mathematical videos, lessons and general teaching resources. This collection is a phenomenal showcase of effective teacher videos to inspire teacher learning and instruction. Check out the new videos related to the CCSS!
6. **Ole Miss Math Contest** (<http://mathcontest.olemiss.edu/>) adds some worldwide competition to the classroom. Students use various mathematical skills to work through the challenge of the week for some friendly math competition. If they are lucky, they may even win an Ole Miss Rebels t-shirt.
7. **101 Questions** (101qs.com) is Dan Meyer's latest mathematical creation. Dan posts photos and then poses his big question, "What's the first question that comes to mind?" Great hooks for lesson starters.
8. **Livebinders** (www.livebinders.com/) is a bookmarking tool with resources galore. Create and organize your own materials. Search through other professional binders to find math content sorted by tabs. All the research is done for you here. You just have to do a quick search. Try searching for "CCSS" and you will be amazed what comes up!
9. **TeachersPayTeachers** (www.teacherspayteachers.com) is open marketplace where teachers buy, sell and share teacher created resources. Creating an account is free and you can download resources for as low as \$1.
10. **Formulator Tarsia** (www.mmlsoft.com) is a free software download. With Tarsia you can create mathematical learning activities (jigsaws, domino activities, card sorting activities, etc) to print out, save and exchange for classroom use.

Don't forget to share your ten!

Secondary Representative: The Long Sunday Night

By Greta Mills

As August approaches, I start to have those familiar nightmares – it's the first day of school and I don't know what classes I am teaching, or my class is out of control, or I encounter all number of mishaps as I try to make my way to class. At the same time, I find myself in breathless anticipation of the first day of school and all that awaits. It is not unlike my state of mind each Sunday before the new week begins – wanting to savor the weekend while simultaneously gearing up for the week. It's no wonder that August is referred to as "The Long Sunday Night" for teachers!

In my last article I focused on the need to promote student collaboration in the classroom, but as I consider the upcoming year, I am thankful yet again that I work in a department that values *teacher* collaboration. I am still amazed when I meet teachers whose colleagues refuse to share any materials, or teachers who are given the least desirable courses until they too have "paid their dues." The teachers who are eager to collaborate often face the very real obstacle of time. It's no wonder teacher attrition rates among new teachers are reported to be as high as 50% over the first five years! I think the feeling of isolation and the overwhelming workload that some new teachers experience contribute to the burnout and attrition. One solution, which promotes both collaboration and support, is the **Professional Learning Community** (PLC).

What is a Professional Learning Community? (Bray, 2005)

A *Professional Learning Community (PLC)* is comprised of people (teachers, paraprofessionals, administrators, and other community members) who collectively examine and collaboratively work to improve teaching practice.

The biggest obstacle in creating a school-based PLC, even in the most supportive of districts, is the requirement of *dedicated time*. One option is to join online PLC's – there are so many out there that you are sure to find one that speaks to you. I personally find that the online PLC's give me a broad view of math education while a school-based PLC allows me to target issues specific to my classroom. The online PLC's also serve as a reminder that not all schools / districts / states are facing the same issues that I might be facing, and it's always interesting to read how others approach issues that we do share.

In our school, our desks are in a common area which enables us to collaborate regularly and continually throughout the day, and receive immediate feedback. In addition, our schedules are often structured so that teachers who teach a common prep also share a common prep period. One of my goals for this year is to use some of my prep periods to observe other teachers, intra- and interdepartmentally, and I think new teachers would also benefit from observing a variety of different classes and teaching styles.

How I Spent My Summer Vacation?

On another note, while vacationing in Southern California (and discovering how much colder it is than I had imagined!), I paid a visit to The Institute for Figuring in Los Angeles. Its mission is to "contribute to the public understanding of scientific and mathematical themes through innovative programming that includes exhibitions, lectures, workshops, and participatory, community based projects." The Institute is where the Crocheted Coral Reef Project originated (<http://crochetcoralreef.org/>). This project uses hyperbolic crochet to create a variety of realistic coral reef

(Continued on page 17)

Nominate Your Colleagues for Distinguished Teaching, Leadership, and Service Awards

Each year NHTM encourages its members to nominate mathematics teachers for the Fernand J. Prevost Teaching Award, the Richard C. Evans Distinguished Educator Award, and the Richard H. Balomenos Memorial Award. In addition, NHTM assists in the process of soliciting and preparing New Hampshire nominees for the national Presidential Award for Excellence in Mathematics and Science Teaching. Nomination forms and applications for each of these awards can be found on the NHTM website www.nhmathteachers.org. The descriptions and instructions for each of these awards are described below:

The Fernand J. Prevost Mathematics Teaching Award

Nominees are being sought for the annual FERNAND J. PREVOST MATHEMATICS TEACHING AWARD. NHTM is presenting the award in recognition of the contribution that Ferd has made to the mathematics educators of New Hampshire during his thirty years as the state mathematics consultant. The award is being given to a beginning teacher in her/his first, second, third, or fourth year who meets the following criteria which exemplify the characteristics which Ferd has brought to his teaching:

- * commitment to good mathematics
- * confidence that children can learn
- * a spirit of self reflection and professional curiosity
- * caring and concern for colleagues
- * a willingness to explore, to learn, and to grow as a teacher of mathematics

- * a willingness to share mathematical and pedagogical activities with others

The recipient will receive a plaque of achievement, a \$250 prize, and a one year membership to NHTM. The presentation of the award will be made at the NHTM Spring Conference.

Nominations are due by December 15, 2012 and should be sent to:

Katrina L. Hall
10 Patch Road
Hollis, NH 03049
Katrinaleighhall@gmail.com
603.289.4923

The Richard C. Evans Distinguished Educator Award

In December 2006, Dr. Richard Evans retired from Plymouth State University after serving for more than 40 years as a mathematics educator. The extent of his work in the State of New Hampshire is enormous. It is difficult to find a mathematics teacher in the State who has not been affected by his work. Dick has an unsurpassed passion for mathematics education and has dedicated his life to improving mathematics education for all in the State of New Hampshire.

The intent of this award is to highlight that passion, creativity and innovation in the teaching of mathematics to all students. The recipient of this award will represent Dr. Evans philosophy, passion and knowledge of mathematics education. Those with 5 or more years experience teaching mathematics at any level from Pre-K to 16 may be nominated.

The award recipient will receive \$500, a plaque, a one year membership to NHTM, become an honorary

board member for one year, be invited to present at the spring conference, invited to contribute articles for the quarterly newsletter, *Mathesis*, and will be encouraged to offer professional development opportunities for mathematics educators with the support of NHTM. The presentation of the award will be made at the NHTM Spring Conference.

Please consider nominating a Pre-K to 16 mathematics educator for the **2012 Richard C. Evans Distinguished Mathematics Educator Award** given by the New Hampshire Teachers of Mathematics. Nomination forms and applications are due by December 15th and should be sent to:

Greta Mills - NHTM Secondary Representative
greta.mills@dresden.us
greta.mills@hanovernorwichschools.org

The Richard H. Balomenos Memorial Award

The Richard H. Balomenos Memorial Award is presented annually to a New Hampshire mathematics educator who has shown outstanding or meritorious service or leadership to the mathematics education community on a statewide basis. Established by the Executive Board of NH-ATMNE in 1987, the award remembers and honors a former colleague, educator, and friend, Richard Balomenos, and his wife, Georgia, who died tragically in an automobile accident in December 1986. As both teacher and administrator at the University of New Hampshire for almost 25 years, Richard had a profound influence

(Continued on page 10)

Ferd Prevost recalls First NHTM Conference

(Continued from page 1)

riculum" and Pieters closed the day by asking: "Where Are We Going?" The section speakers - there were breakouts for secondary, junior high (no middle schools in '64), and elementary teachers - were, respectively: Bob Eddy from St. Paul's (*Probability*), Bill Slesnick from Dartmouth (*Coordinate Geometry in the Junior High*), and Barbara Curtin, a Consultant from Silver Burdett (*The Changing Program*).

Registration, which included a Yankee Pot Roast luncheon, was \$3.00. Since we didn't have a structure to receive money for the association, one registered with the understanding that you'd pay "on site" on Saturday. It

worked out well!

Among the 300 attendees that day was Ed Wixson, now professor emeritus at PSC/PSU. (It probably was Plymouth Teachers College in '64, as was Keene State.) If you, or someone you know, was there, do let us know.

We will hold the 50th **Annual** Meeting on April 4-5, 2013 in Manchester – date and location quite appropriate! And, note, that 2013 – 1964 is 49 – but "2013-1964, inclusive", is 50! So as our first meeting in '64 signaled our first year as an association, the meeting in Manchester will commence our 50th Anniversary Year.

The optimism of '64 was by no means misplaced!

Nominees Sought for Annual NHTM Awards

(Continued from page 9)

on mathematics education in the state of New Hampshire.

If you would like to nominate someone for the Richard H. Balomenos Memorial Award, please send his/her name and a 1-2 page letter describing contributions to the State of New Hampshire in the field of mathematics education to:

Greg Superchi
NHTM President
159 Jim Noyes Hill Rd.
Landaff, NH 03585

All nominations must be received by January 1. A list of previous recipients is posted on the NHTM website www.nhmathteachers.org.

Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST)

The Presidential Awards for Excellence in Mathematics and Science Teaching are the Nation's highest honors for teachers of mathematics and science. Awardees serve as models for their colleagues, inspiration to their communities, and leaders in the improvement of mathematics and science education. NHTM is proud of the most recent NH PAEMST awardee for grades K-6 mathematics, Stephanie Wheeler. Currently, Stephanie is the elementary representative on the NHTM board. Nominations for 7-12 mathematics educators will begin in fall 2012. If you know great mathematics teachers in grades 7-12, nominate them to join this prestigious network of professionals. For more information about nominations and the PAEMST application, please visit www.paemst.org or contact Christine Downing, State Coordinator for NH PAEMST Mathematics at Christine.downing@yahoo.com.



Mentors Needed!

If you are a past Presidential Awards for Excellence in Mathematics and Science Teaching awardee in Mathematics for NH and are interested in possibly mentoring potential PAEMST applications for the upcoming school year, please contact Christine Downing, State Coordinator for NH PAEMST Mathematics, at christine.downing@yahoo.com.

While Some Vacation, We “ASP”

By David Harvey

“How do you do four hours of math in a row every day?” Most people won’t believe any answer you give them to this question, especially when it’s mid-July. Nonetheless, it’s a question one gets asked when part of the Advanced Math class at St. Paul’s School’s summer academic enrichment program for NH public school juniors. This five-week program, the Advanced Studies Program (ASP), takes place on the school’s campus in Concord from mid-June through late July. Although the math students actually spend four hours in math class only three days a week, and two-and-a-half hours doing math the other three class days (Saturday, too, is a class day at St. Paul’s), students routinely spend several more hours problem solving each evening as well.

What makes Advanced Mathematics “advanced”, you might ask? Interestingly enough, the content of the course is chosen for both what it is not, as well as what it is. The content lies outside that of standard courses in a high school math curriculum, and success in the course depends little on the students’ high school background. What it does depend on is their willingness and enthusiasm to respond to novel, multi-step, challenging problems with a sustained and skillful application of analytical and mathematical reasoning.

The course itself functions as a system of two mini-courses: game theory and graph theory. Game theory is the mathematical analysis of conflict and cooperation, where “players” can include individuals, corporations, governments, or even nature. The theory attempts to predict, explain or recommend courses of action in situations where one player’s success depends on the decisions of all players. The theoretical analysis of such situations is taught through applications in economics, politics, business, evolutionary biology, religion, philosophy, computer science, and sports, as well as through games such as poker and chess. We develop quantitative models for strategic situations, and analysis includes optimization and graphical analysis. The Prisoner’s Dilemma is the most well known example from game theory.

Graph theory is the study of the properties of “graphs” consisting of vertices interconnected by edges. Because complex problems of transportation, structural engineering, networking, flow, optimal matching, and minimum distance can often be represented by such graphs, knowledge of graph theory allows for a ready analysis of and solution to such problems. Classical problems in graph theory studied in this course include the Bridges of Königsberg, the Traveling Salesman Problem and the Stable Marriage Problem.

Lastly, through research, anecdotes and short films, students develop familiarity with the names, personalities and contributions of the people who developed the body of knowledge they study.

Variety in the mode of instruction is needed to maintain a high level of student engagement, focus and energy across many hours. Class activities vary between the playing of “games”, class discussion, group work, student research and presentations, applet-aided explorations, and tactile activities. Evening work varies from being independent to fully collaborative depending on the task at hand and the working style of each student.

The course is punctuated by several special events. We travel to UNH each summer, where Professor Ernst Linder, a professor and researcher in statistics puts together a one-day program to introduce students to topics, tools, methods and careers available to those who pursue work in mathematics and statistics. This year featured computer-aided student activities in predictive analytics using real medical biopsy data sets, and a Monte Carlo simulation to determine the value of pi experimen-

(Continued on page 15)

WANTED

Writer for State Mathematics Competition

Each year NHTM and the Mathematics Departments of the University System of New Hampshire invite high schools to form ten member mathematics teams to compete in the state mathematics competition. Teams have the opportunity to meet with other students from throughout the state and solve challenging mathematics exercises in six different categories – Team, Recreational Mathematics, Algebra I, Geometry, Algebra II, and Advanced Mathematics.

The questions for the state mathematics contest are written by a secret committee. One of the members of this writing committee, pictured here, is retiring. Thus, the writing committee is looking for a new member. If you are interested in this volunteer position, please send an e-mail to nhmathcontest@gmail.com.

While the writing committee can not mention the retiring member by name (since the committee is secret after all), they would like to sincerely thank this member for years of dedication. The committee wishes this member the best.



Across the Regions

NHTM's regional coordinators plan small events like networking gatherings or NCTM E-Seminars for teachers in their region. They forward NHTM information to an e-distribution list and seek cooperation from other NHTM members in their region. Look for more events in the fall!

Southern Region: Lauren Provost writes: Look for a new PD evening event at the Seacoast Professional Development Center. We will start the year with an event that is purely lesson-sharing of high quality lessons using technology in mathematics. The PD event will include lessons that are useful when technology is limited. All lessons will be standards-based and catered to your classroom needs. This event will be formally announced soon via e-

mail.

We are still looking for a Central coordinator (or a pair of co-coordinators). If you're interested in volunteering, contact Katrina Hall or any NHTM Board member.

Regional Coordinators:

North: Kim Knighton kknig@profile.k12.nh.us

Southwest: Bernadette Kuhn bkuhn@mrsd.org

West Central: Greta Mills greta.mills@dresden.us

South Central: Katrina Hall

katrinaleighhall@gmail.com

Central: open

South East: Lauren Provost laureneliz2@yahoo.com

Making Connections with Linear Functions

(continued from p. 4)

to three dimensions.

A linear function in two variables is one whose graph is a plane. In Linear Algebra, I learned that a plane was determined by a point and a normal vector. Suppose we have a plane passing through $P_0(x_0, y_0, z_0)$ with normal vector $\vec{N} = Ai + Bj + Ck$, how can we determine if $P(x, y, z)$ is on the plane? P is on the plane if $\vec{N} \cdot \vec{P}_0\vec{P} = 0$ ($\vec{P}_0\vec{P}$ is perpendicular to \vec{N} so the dot product is 0). Since $\overline{P_0P} = (x - x_0)\hat{i} + (y - y_0)\hat{j} + (z - z_0)\hat{k}$, we have $A(x - x_0) + B(y - y_0) + C(z - z_0) = 0$ or $Ax + By + Cz = D$ where $D = Ax_0 + By_0 + Cz_0$. At this point, one begins to wonder about the connections between the two-dimensional case and the three-dimensional case. While this is a typical way that the equation of a plane in three dimensions is developed, we haven't explicitly made strong connections to slope. What connections exist? One such connection is to consider a plane that has slope m in the x -direction and slope n in the y -direction and passes through the point $P_0(x_0, y_0, z_0)$. Then, $\frac{\Delta z}{\Delta x} = m$ and $\frac{\Delta z}{\Delta y} = n$ (with y fixed and x fixed, respectively). Thus, if from P_0 you travel $x - x_0$ units in the x -direction and $y - y_0$ units in the y -direction, the height changes by $m(x - x_0) + n(y - y_0)$. Hence, the equation of the plane with slope m in the x -direction, slope n in the y -direction, and passing through the point $P_0(x_0, y_0, z_0)$ is $z = z_0 + m(x - x_0) + n(y - y_0)$ and the plane is the graph of the linear function in two variables $f(x, y) = c + mx + ny$, where $c = z_0 - mx_0 - ny_0$. Now that we've integrated slope elements into the equation of the plane, we could look for connections between the two different forms of the equations of the plane and connections to the two-dimensional case. We could also look at typical examples that we explore in the two-dimensional case. For example, could the following table represent a linear function?

x	10	15	20	30	35	40
y	2	4	6	8	10	12

What about the three-dimensional case? How can we tell by looking at a table (right) if the data could come from a linear function?

Many more questions and connections can be explored, but all of these thoughts stemmed from a grade 2 assessment tasks focusing on addition facts. I'd be interested in hearing about connections that you are helping students make. If you would like to write to me, you can contact me at randrusiak@ccsnh.edu.

x\y	1	2	3
1	5	7	9
2	8	10	12
3	11	13	15

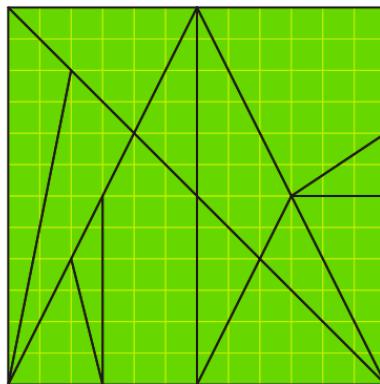
Art's Attic: Stomachion

(Continued from page 2)

des proposes repeating the process ad infinitum, in this way anticipating and setting the stage for calculus. It is the first time any mathematician grappled with the idea of infinity.

Another of Archimedes works in the Codex is *Stomachion* (“Belly buster”), and involves the geometric figure shown.

An early translation of some parts of the Codex had uncovered the title of the article and some parts of the work, but it was thought to be simply an article on recreational mathematics. A century later modern technology has revealed the details of the manuscript. In it Archimedes posed the question as to how any different combinations of these 14 shapes could produce the same square. Essentially, Archimedes invented another area of mathematics, combinatorics. Combinatorics focuses on all the distinct combinations possible in a given setting, usually described as group theory. For example, if each face of a number cube is a different color, how many distinct



[http://www.puzzles.com/puzzleplayground/
Stomachion/Stomachion.htm](http://www.puzzles.com/puzzleplayground/Stomachion/Stomachion.htm)

number cubes are possible? More to the point, how many distinct squares in *Stomachion* are possible? A computer program has determined that 17,152 are possible, a number independently found by mathematicians using only pencil and paper (or reed and papyrus as Archimedes would have done). Certainly Archimedes was not posing a recreational problem with 17,152 answers. Some years ago, when *Stomachion* was only a curiosity about some shapes, I ordered a *Stomachion* jigsaw puzzle. The set of 14 pieces arrived in the shape of a square, and I was very careful not to disturb what I thought was the unique solution. I envisioned somehow dropping the square and never being able to arrange the pieces to recover it. Now that I know there are over 17,000 ways to make a square, I am not so careful. Still, I am reluctant to put all the pieces in a pile and then try to make the square. How about you? Cut out the pieces in the diagram above and see if you can make a square.

So, there you have it. Archimedes has always been in the top three. The Codex shows he invented two new fields of mathematics. Sufficient in my mind to put him at the top.

Support Mathematics Education in New Hampshire.

Renew your membership to NHTM and encourage your colleagues to join!

Eight Mathematical Practices

(Continued from page 5)

- ◊ Multiples of 3 are every third number!
 - ◊ Odd numbers are every other number starting at one!
- Practice #8: Look for and express regularity in repeated reasoning.**
- **Generalizations and “Shortcuts”**
 - ◊ When you add 10 to any number on the hundreds chart, where do you end up? What is the generalization we can make?

Summer Program Engages High School Students

(Continued from page 11)

tally.

We also visit the Boston Museum of Science's *Mathematica* exhibit. Though intended for the non-specialist, the exhibit's displays and models serve as a starting point for more advanced mathematical conversations between students and me right there in the exhibit hall. As you might imagine, we often find museum visitors trying to surreptitiously eavesdrop with the same attentiveness they would give a docent on a guided tour.

A particular highlight of each summer is the visit of New York University Professor of Politics, Steven Brams. Dr. Brams is best known for applying game theory and social choice theory to the areas of voting method and fair division. He presents his recognized discoveries of approval voting and fair division procedures to the students, as well as leading an inspiring discussion about his most current research. Of note is the fact that Dr. Brams is a Concord native, a Concord H.S. graduate, and a member of the first ASP math class of 1958!

The course reaches its climax with the Math Carnival, an event in which many of the students and faculty from all of the program's courses come to compete for prizes in carnival-like versions of the game- and graph-theoretic problems that we've studied throughout the course, all created by students in the math course. It's Dartmouth meets Hampton Beach!

In the end, we realize that the success of the ASP depends on the good work that New Hampshire teachers have done in preparing and inspiring the students who attend. You have helped develop them into students who embrace the challenges we place before them each summer. In return, we, the ASP teachers, actively encourage students to bring what they have learned from us about mathematics, collaboration and hard work back to their schools to share with their peers and teachers. I therefore invite you to encourage these students to put what they have learned to use through independent projects, class presentations and the like. Though there has never been a shortage of talented students to teach, I also invite you to further encourage female applicants with a strong interest in mathematics to apply. Girls and boys have been equally successful in the math course, but the class has a consistent majority of boys. In the same way that ASP students revel in working together each summer, it would be a pleasure to collaborate even more actively with you in helping New Hampshire's youth succeed!

For more information on the Advanced Studies Program visit the website at asp.sps.edu or contact director Michael Ricard at asp@sps.edu.

Respectfully,
David Harvey
dharvey@dalton.org
New York, NY

NHMathEd Listserv

Are you a member of the NHMathEd listserv? This is a free service for Mathematics Educators throughout the state of New Hampshire. Messages relating to workshop opportunities, participation in projects, collaboration with fellow mathematics educators; and much more are posted through this service.

Use the link <http://toto.plymouth.edu/mailman/listinfo/nhmathed> and follow the directions provided. If you have questions about this service, contact Christine Downing at Christine.downing@yahoo.com. Please consider joining today!

NCTM 2012 Math Education Conference & Exposition

HARTFORD, CT
OCTOBER 24–26

Join the Best & Brightest Math Educators

NCTM's Regional Conferences have the professional development opportunities you need to help your students succeed. Join the best and the brightest and immerse yourself in the latest topics in math education. By attending you and your colleagues will:

- Learn more about and test the latest **technology**
- Discover new and effective **Intervention** methods
- Learn practices central to teaching the **Common Core State Standards**

- Refine your **assessment** techniques
- And more!

Whether you're a classroom teacher, coach, administrator, preservice teacher, or math specialist, this conference has something for you.



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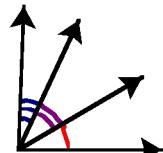
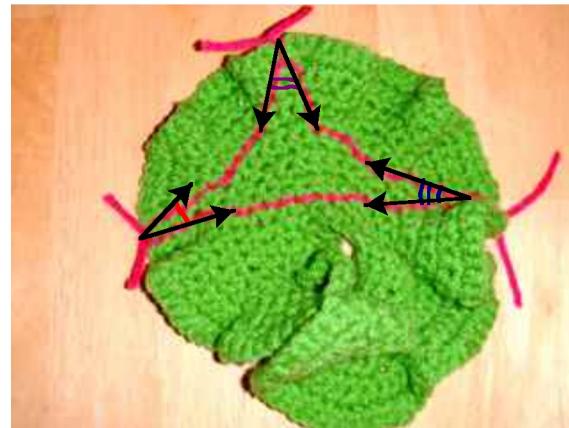
Visit www.nctm.org/meetings for up-to-date information.

Illustrating Non-Euclidean Geometry by Crocheting the Coral Reef

(Continued from page 8)

models. The director of the institute, Margaret Wertheim, gave a TED talk about crocheting the coral reef in 2009.

Hyperbolic crochet models are of particular interest to me as they are a relatively simple way of creating models that physically and kinesthetically demonstrate both exponential growth and properties of Non-Euclidean geometry. For more information on crocheting hyperbolic planes or using hyperbolic crochet in the classroom, feel free to contact me at greta.mills@dresden.us.



Crochet model demonstrating the sum of the angles of a triangle on a hyperbolic plane is less than 180°

NCTM Affiliate Leadership Conference Benefits NHTM Board

By Terri Magnus

Each summer, NCTM holds an Affiliate Leadership Conference for teams of current and potential leaders of affiliates such as NHTM. Participants have the opportunity to explore and develop their own leadership styles, to learn what other affiliates are doing, to assess one's own affiliate structure and develop strategic plans, to learn more about the structure of

NCTM and its services to affiliates, and to gain insight into how the NCTM can help the affiliates support teachers.

NHTM's regional structure was inspired by Nancy Broder's trip to the ALC a few years ago. This summer, Rob Lukasiak, ATMNE Representative, and Annie Wallace, NCTM Representative, represented NHTM at the conference in Atlanta. Last year's conference in Denver was attended by Greg Superchi, then NHTM President-Elect, and Rich Andrusiak, NHTM Post-Secondary Representative.



NCTM President, Linda M. Gojak, (center) is pictured with NHTM Board members Rob Lukasiak and Annie Wallace at Atlanta's Affiliate Leadership Conference in August.

From the desk of the membership Chair:

RENEW and/or Invite Others to Join NHTM

Now is the time to renew! Check your mailing label! If it reads **SY 2011-2012** – you need to renew by December 15th to be current in our database. Use the application form in this issue, go to the web site for a renewal application form, or watch your snail mail for a renewal notice. Let NHTM be your state level professional conduit that extends your networking with mathematics colleagues. Enhance your effectiveness, mathematical expertise, and teaching skills. Invite a colleague to join. *Application available at web site www.nhmathteachers.org. Contact *Cecile Carlton, Membership Chair* if you have any further questions: Cecile.carlton@comcast.net.

Individual membership in NHTM provides you with:

- Mathesis (newsletter) - includes current happenings (including Common Core resources) in math education, interesting articles and activities
- Reduced rates at Fall Dine & Discuss (November 5, 2012) and Annual Spring Conference (50 Years Celebration in April 2013!)
- Membership in ATMNE (the Association of Teachers of Mathematics in New England) including its two publications, the ATMNE Newsletter and the New England Mathematics Journalm and reduced rates to ATMNE conferences. Note that the ATMNE Newsletter has gone GREEN – be sure your e-mail is up to date in our database.
- In-Service Education Forums on current Math Ed initiatives – Regional PD offerings, networking

If you teach **elementary** grades, the New Hampshire Joint Elementary Membership (NH-JEM) may be for you! A \$50 annual fee gives you most of the membership benefits of four organizations (NHTM, New Hampshire Council of Teachers of English, New Hampshire Council for the Social Studies, and New Hampshire Science Teachers Association). See web site www.nhmathteachers.org for details. Note that NH-JEM membership does not include ATMNE benefits.

Your membership supports:

- Scholarship programs for graduating high school seniors who will pursue mathematics related college studies and for college students enrolled in mathematics education programs
- State Mathematics Contest for high schools students and MATHCOUNTS for middle school students in New Hampshire
- Student Recognition program -for students who have demonstrated creativity, interest, or talent in the study of mathematics
- **Mathematics Educator Recognition Programs:**
 - ◊ **Richard H. Balomenos Memorial Service Award**
 - ◊ **Presidential Awardees (PAESMT)** at the elementary and secondary levels
 - ◊ **Fernand J. Prevost Mathematics Teaching Award** -for outstanding teacher of mathematics in their first, second, or third year of teaching
 - ◊ **Richard C. Evans Distinguished Mathematics Educator Award** – for distinguished mathematics teacher/educator who works actively with students and/or teachers for five or more years at any level (PreK – 16)
 - ◊ Recognition of math educators with **25 or more years of service**
 - ◊ Lifetime Honorary Membership

Institutional Memberships

NHTM offers all of the many benefits of an individual membership to elementary schools containing grades six and below. An elementary school may join NHTM through an institutional membership which will allow staff members to attend conferences at the membership rate. All publications will be received by a named contact person.

NHTM Executive Board

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<u>Secretary</u>	Amanda Benware, Bedford High School	benwarea@sau25.net
<u>Treasurer</u>	Connie Upschulte, Pennichuck Middle School, Nashua	upschultec@yahoo.com

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Please visit <www.nhmathteachers.org> for more detailed Board information.

News Bytes

- Check out the Core Math Tools, a downloadable suite of interactive software tools for mathematics education available free through the NCTM at <http://www.nctm.org/resources/content.aspx?id=32702>. The tools include a computer algebra system, a spreadsheet, and applications for dynamic geometry, data analysis, and simulation. Lesson plans, educational apps, and data sets are provided and the library is expected to grow. These tools are accessible to everyone with an internet connection in the hope of being accessible to all students.
- Web Interface for Statistical Education (WISE) <http://wise.cgu.edu/> connects students and teachers of statistics with a wide range of free internet resources.
- University of New Hampshire announces an online graduate course, EDUC 720/820 Integrating Technology in the Classroom, offered in Fall 2012. The course will be differentiated so that teachers can focus on their own content area and grade level with the goal to create quality technology-based lessons that teachers will use while they are enrolled and after they leave the course.
- Rivier University in Nashua NH offers an evening M.A.T. (Masters of Arts in Teaching) Mathematics program for current and prospective teachers. Fall courses including Discrete Mathematics, Mathematical Statistics, and Methods of Teaching 5-12 Mathematics begin September 4. All classes start at 4 p.m. or later. Contact Terri Magnus at tmagnus@rivier.edu or visit www.rivier.edu.

**Department of Mathematics
Plymouth State University
Plymouth NH 03264**

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Professional Development and Conferences

National

AMATYC 38th Annual Conference	Jacksonville FL	8 -12 November 2012
Joint Mathematics Meetings	San Diego CA	9 - 12 January 2013
NCSM 45th Annual Conference	Denver CO	15 - 17 April 2013
NCTM 91st Annual Meeting & Exposition	Denver CO	17 - 20 April 2013
T3 Annual Conference	Philadelphia PA	8 - 10 March 2013
ICTCM 25th Annual Conference	Boston MA	21-24 March 2013

Regional

NCTM	Hartford CT	24-26 October, 2012
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State

NHTM Dine & Discuss	Concord NH	5 November 2012
Christa McAuliffe Technology Conference	Manchester NH	27 - 29 November 2012
NHTM Annual Spring Conference	Manchester NH	4-5 April 2013
41 st annual State Mathematics Contest	TBA	March 2013

Mathesis is the newsletter of the New Hampshire Teachers of Mathematics. It is published four times a year: August, November, February, and May. The mission of the New Hampshire Teachers of Mathematics is to provide vision and leadership in improving the teaching of mathematics so that each student is ensured quality mathematics education and each teacher of mathematics is ensured the opportunity to grow professionally.