

Mathesis

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NHTM Meeting Features Productive Discussions

Upcoming Deadlines:

- May 23/June 23 Register for NHTM [trip](#) to Museum of Mathematics in NYC.
- September 15: Early bird Registration for [ATMNE Conference](#).
- May 22/June 26: Early bird and regular registration deadlines for NCTM Summer Interactive Institutes.

This year's NHTM Spring Meeting took place over dinner at the Holiday Inn, Concord NH, Wednesday, March 25. Shawn Towle, Eastern 1 Region Representative for the NCTM Affiliate Services Committee, presented the keynote address entitled "Deepening Our Understanding of How to Plan For and Structure Productive Discussions." The Fernand J. Prevost Mathematics Teaching Award was presented to Goffstown High School teacher, Nathan Bracy, and the Richard H. Balomenos Service Award went to Greg Superchi, NHTM Past-President and Lisbon Regional School teacher. NHTM Membership Chair Gretchen Scruton presented a 25-year NHTM Membership Recognition to Kathy Fowler.

Participants were presented with a treasurer's report and an overview of the past year's activities. The NHTM Board would like to thank Pearson for sponsoring the meeting and Texas Instruments for providing door prizes.

With the NCTM National Meeting taking place in neighboring Massachusetts a few weeks later, NHTM chose not to offer a full conference this year. We look forward to seeing everyone at next year's full-day conference at UNH Manchester.

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Judy Curran Buck, former NHTM president, and Cecile Carlton, current NHTM President, meet the Red Sox mascot Wally at Math Educators' Night at Fenway.

Art's Attic:

Math History Comes to New Hampshire

By Art Johnson

It is not often that mathematics history happens in New England, but it has, and at UNH! Professor Yitang Zhang has made a breakthrough in one of the oldest problems of mathematics: the twin prime conjecture.

Twin primes are prime numbers that differ by 2. There are lots of twin primes: 11 & 13, 19 & 21, 41 & 43, etc. But as you move along the number line, twin primes are less evident, and the gap between consecutive prime numbers grows ever larger. Zhang's 'bounded gap proof' shows that although prime gaps continue to increase, no matter how far along the number line you go, prime pairs will always differ by less than 70 million. His proof set off explorations and collaborations across the mathematics community, and the gap of 70 million has been reduced to less than 5,000.

Dr. Zhang published his proof in the *Annals of Mathematics* in 2013, but the news of the proof did not get into the mainstream media until this past year when he won the MacArthur Award. The MacArthur Fellows Program, MacArthur Fellowship, or simply "Genius Grant" is a prize awarded annually by the John D. and Catherine T. MacArthur Foundation typically to between 20 and 40 individuals, working in any field, who "show exceptional merit and promise for continued and enhanced creative work" and are citizens or residents of the United States. According to the Foundation's website, "the fellowship is not a reward for past accomplishment, but rather an investment in a person's originality, insight, and potential." The current prize is \$625,000 paid over five years in quarterly installments.

According to Dr. Zhang, the award, and the size of the stipend surprised him. "I never considered it a possibility." The details of his proof

are well beyond the scope of a typical public school student, and likely most teachers as well. There is, however, an interesting aspect of prime numbers within reach of most students: Goldbach's Conjecture.

Goldbach's Conjecture is named for Christian Goldbach (1690-1764), who was known in mathematical circles as no more than an average practitioner. More notably, he was an official in the Russian government who maintained his position through two decades of upheavals that saw six changes in the tsarist rulers. When Goldbach began serving the tsarist government, it was as a tutor to the Peter II, the son of Peter the Great. Over the next twenty years Goldbach rose to a position of high influence, and maintained his place despite the frequent political upheavals.

In 1742 he wrote to Leonhard Euler and proposed the following conjecture

Every integer greater than two can be written as the sum of three primes.

Because Christian Goldbach considered 1 to be a prime number and modern mathematics no longer recognizes 1 as a prime, an equivalent and modern rendering of his conjecture is:

Every integer greater than 5 can be written as the sum of three primes.

$$8 = 2 + 3 + 3; 10 = 2 + 3 + 5; 17 = 3 + 3 + 11$$

Such a simple statement can be verified almost as soon as students understand the difference between prime and composite numbers. The proof, however, has resisted the best efforts of mathematicians for nearly 300 years. You might present Goldbach's Conjecture to your students and ask them to verify it for several cases. Who knows, perhaps in the future one of your students will find the elusive proof!

President's Message:

Why we serve...

By Cecile Carlton

Why do we serve? What is the purpose for joining professional organizations? We, the mathematics teachers in New Hampshire are the organization and it is what we put into it. Volunteers, ...we are a group of volunteers coming together for a common purpose. That purpose is to promote a comprehensive math education community, provide leadership in supporting educators in continuous improvement in the teaching and learning of mathematics so that each student in the state is ensured quality mathematics education and each teacher of mathematics is ensured the opportunity to grow professionally.

Over the winter months NHTM has provided support to students by sponsoring the New Hampshire State Mathematics Contest – read about the results of the work done by Stephen Latvis and his group of dedicated mathematics teachers combined with the continued support of PSU mathematics educators Shawn Hackshaw and John Donovan – a huge thank you to all of them.

Our organization also believes in sharing and collaborating with others in the field. At our March 25th Spring Conference Dinner/Awards night – we had the pleasure of hearing from Shawn Towle, NCTM's Eastern 1 Region Affiliate Services Committee Representative, who delivered the keynote address– which was held at the Concord Holiday Inn. The title of Shawn's talk was "Deepening Our Understanding of How to Plan For and Structure Productive Discussions." His interactive and thought provoking presentation focused on five practices for facilitating effective inquiry-oriented classrooms. The ideas are based on the NCTM publication 5 Practices for Orchestrating Productive Mathematics Discussions (Smith and Stein 2011). Here are some highlights from that book –(look into it if you are part of a professional learning community looking for ideas for a book share for next year – or over the summer. You can always get the e-book from NCTM).

Research tells us that complex knowledge and skills are learned through social interaction

(Vygotsky 1978; Lave and Wenger 1991). We learn through a process of knowledge construction that requires us to actively manipulate and refine information and then integrate it with our prior understandings. Social interaction provides us with the opportunity to use others as resources, to share our ideas with others, and to participate in the joint construction of knowledge. In mathematics classrooms, high-quality discussions support student learning of mathematics by helping students learn how to communicate their ideas, making students' thinking public so it can be guided in mathematically sound directions, and encouraging students to evaluate their own and each other's mathematical ideas. These are all important features of what it means to be "mathematically literate." Creating discussion-based opportunities for student learning will require learning on the part of many teachers. It is not a result of putting students together and letting them talk. There are behind the scenes preparations teachers need to attend to in order for the process to evolve to productivity – this will occur over time.

The groundwork needs to be laid. First, teachers will need to learn how to select and set up cognitively challenging and instructional tasks in their classrooms. These high-level tasks provide the grist for worthwhile discussions. Over the years, however, most textbooks have fed teachers a steady diet of routine, procedural tasks around which it would be difficult, if not impossible, to organize an engaging discussion. Second, teachers must learn how to support their students as they engage with and discuss their solutions to cognitively challenging tasks. We know from our own past research that once high-level tasks are introduced in the classroom, many teachers have difficulty maintaining the cognitive demand of those tasks as students engage with them (Stein, Grover, and Henningsen 1996). Students often end up thinking and reasoning at a lower level than the task is intended to elicit. One of the reasons

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President's Message

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for this is teachers' difficulties in orchestrating discussions that productively use students' ideas and strategies that are generated in response to high-level tasks. A typical lesson that uses a high-level instructional task proceeds in three phases. It begins with the teacher's launching of a mathematical problem that embodies important mathematical ideas and can be solved in multiple ways. During this "launch phase," the teacher introduces students to the problem, the tools that are available for working on it, and the nature of the products that the students will be expected to produce. This phase is followed by the "explore phase," in which students work on the problem, often discussing it in pairs or small groups. As students work on the problem, they are encouraged to solve it in whatever way makes sense to them and be prepared to explain their approach to others in the class. The lesson then concludes with a whole-class discussion and summary of various student-generated approaches to solving the problem. During this "discuss and summarize" phase, a variety of approaches to the problem are displayed for the whole class to view and discuss.

Why are these end-of-class discussions so difficult to orchestrate? Research tells us that students learn when they are encouraged to become the authors of their own ideas and when they are held accountable for reasoning about and understanding key ideas (Engle and Conant 2002).

The key is to maintain the right balance. Too much focus on accountability can undermine students' authority and sense making and, unwittingly, encourage increased reliance on teacher direction. Students quickly get the message—often from subtle cues—that "knowing mathematics" means using only those strategies that have been validated by the teacher or textbook; correspondingly, they learn not to use or trust their own reasoning. Too much focus on student authorship, on the other hand, leads to classroom discussions that are free-for-alls.

Explore and study this book with others - The five practices from —5 Practices for Orches-

trating Productive Mathematics Discussions include:

1. anticipating likely student responses to challenging mathematical tasks;
2. monitoring students' actual responses to the tasks (while students work on the tasks in pairs or small groups);
3. selecting particular students to present their mathematical work during the whole-class discussion;
4. sequencing the student responses that will be displayed in a specific order; and
5. connecting different students' responses and connecting the responses to key mathematical ideas.

There is more to this discourse than definitions. Examples, discussions and worthwhile task considerations are all part of a very informative book for those who are continuous learners and like to have some fundamental examples to help one capitalize on its worth. The chapters include:

1. Introducing the Five Practices
2. Laying the Groundwork: Setting Goals and Selecting Tasks
3. Investigating the Five Practices in Action
4. Getting Started: Anticipating Students' Responses and Monitoring Their Work
5. Determining the Direction of the Discussions: Selecting, Sequencing, and Connecting Students' Responses
6. Ensuring Active Thinking and Participation: Asking Good Questions and Holding Students Accountable
7. Putting the Five Practices in a Broader Context of Lesson Planning
8. Working in the School Environment to Improve Classroom Discussions

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President's Message

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On March 25, 2015, NHTM also recognized Nathan Bracy from Goffstown High School. He was the recipient of the Fernand J Prevost Mathematics Teaching Award – Congratulations Nathan! And congratulations to Greg Superchi, Past-President for all his time and service to NHTM – Greg was the recipient of our Richard H. Balomenos Memorial Award. In May, we will be reviewing applications and plan to identify a high school senior and a college student as recipients of our organization's scholarships.

Have a productive end to your school year and become revitalized over the summer. In the coming year NHTM will be planning our annual Spring Conference as well as hosting and planning the ATMNE Fall 2016 mathematics conference. We will need volunteers. If you can offer time chairing or serving on committees do contact me at Cecile.carlton@comcast.net. Please get involved and help NHTM become an even stronger support for you as a mathematics teacher, leader, teacher educator, or researcher.

... before I forget – we are planning a 2 day trip to New York City on July 23-24, 2015 to get to the Museum of Mathematics and take in a Broadway play (perhaps)... watch for details – when all is pulled together we will have information on web site – we will also be sending out notifications – so hopefully your membership is current!

On a final note: Congratulations go out to Amy Gregoire, a Math Specialist at Bow Memorial School who was elected as Elementary Representative, Terri Magnus from Rivier University will now represent us as NCTM representative, Jeanine King from Hanover High School who will take over the reins as Treasurer and of course – Annie Wallace will serve as President-Elect. A huge thank you to Sharon Mc Crone and Jessica Jacques for throwing their names into the election ring, and thanks to Stephanie Wheeler who served for many years as Elementary Representative, Annie Wallace who served as NCTM representative, Terri Magnus who dutifully did a wonderful job as Mathesis Editor and Kellie Gabriel who helped bring our Treasurer role into the technology age. It is through the efforts of these dedicated individuals that NHTM is able to continue to serve the mathematics teaching community.

Volunteers Wanted for 2016 ATMNE Math Conference!

New Hampshire Teachers of Mathematics are starting to plan for the ATMNE 2016 Fall Conference. We need help from NHTM members. The conference is scheduled for October 20-21, 2016 in Manchester NH.

We are looking for volunteers to assist (or serve as chairs) on the following committees: Exhibits; Hospitality and Special Events; NCTM Bookstore; Registration and Membership; Session and Workshop Support; Signs and Printing; and Student Hosts. If you have expertise or just want to help, please send me your name and contact information. We can do a great job if we work together!

Cecile Carlton, e-mail: Cecile.carlton@comcast.net
ATMNE 2016 Co-Chair
NHTM President 2014-2016

Secondary Representative

All Aboard the Math Train and Other Lessons from NCTM Boston

By Michelle Fox

NHTM Boston 2015...what an experience! From the opening keynote on Wednesday night to the last workshop I attended on Saturday, it was definitely a memorable and energizing professional development opportunity.

I brought back a few things that I immediately implemented that I would like to share with you all. One of them was courtesy of Lee Stiff, who I had the pleasure of meeting in Washington, DC in 2012 at a summer NCTM High School Institute. I often use the analogy of a “math train” when I am dealing with my upper level mathematics student. I tell them that they can be on the train, left at the station, or have “fallen off” the train. I use this as a humorous, but often realistic, comment on their progress on a particular topic or activity we are doing in class. Lee used the same analogy during his talk in Boston, but he actually shamed me...he said this: “It is better to have all of your students on the train and never make it to the station than leave those students at the station.” And he then went on to explain that the students that are on the train will have less distance to “walk” when they are all on the train to begin with. I felt like he was talking directly to me. I knew that what he was saying was right, and that I had been, in some cases, doing a disservice to my students that

had been “left behind” along the way. So...I guess the moral of the story is this: I knew that he was right, and that I needed to make sure that I had them all with me and that that was just good teaching practice. So, in the future – note to self – make sure I do one more “all aboard” call before I leave the station on my math train!

The other thing that I brought back from Boston was a renewed sense of problem solving. The good, meat-and-potatoes kind that really make students think about the math and doesn’t rely on regurgitation. Real problems...ones that students must struggle with (productive struggle) and that might force them to fix their own mistakes along the way. Making mistakes is actually more beneficial to students than getting the right answer. Jo Boaler’s keynote made this quite clear: making mistakes will actually grow a students’ brain. My goodness. Imagine that. If at first you don’t succeed, try try again...perseverance!

So, in short, there were many wonderfully mathematically awesome things that went on in Boston. Some of them were inspiring and rejuvenating. I will be making my year end on the most positive note possible, and be using the information, ideas, and inspirations that I got in Boston to plan for future changes in my classroom that will make it the best it can possibly be.

Do you want to recognize a student’s “Outstanding Achievement in Mathematics”?

NHTM Student Achievement Certificates are available to any and all NHTM Members sent directly to you *free of charge.* *Unfortunately, four certificates per school is the limit.*

Contact Michelle Fox at m_fox@sau58.org for more information or to order certificates for your school!

NHTM 2015 Awards Honor Deserving Teachers

At the March 25 meeting, New Hampshire Teachers of Mathematics announced the recipients of this year's Fernand J. Prevost Teaching Award and Richard H. Balomenos Memorial Award. There was no Richard C. Evans Distinguished Mathematics Educator Award given this year. In addition, Kathy Fowler was recognized for twenty-five years of NHTM membership. Nominations for 2016 awards will be accepted in the fall.

Fernand J. Prevost Mathematics Teaching Award

Citation read by Katrina Hall, NHTM Middle School Representative, and Pat Marquette, 2013 Prevost Award Recipient.

NHTM presents the annual Fernand J. Prevost Mathematics Teaching Award in recognition of the contributions that Ferd Prevost 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 or his first, second, or third year who exemplifies the following characteristics that Ferd has brought to his teaching:

- *commitment to good mathematics,
- *confidence that all 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, and,
- *a willingness to share mathematical and pedagogical activities with others.

The recipient will receive a plaque of achievement, a monetary prize, and a year's membership to NHTM.

I would like to encourage each of you to consider nominating your outstanding young colleagues next Fall for this award. Look for information in November and at our website.

This year's recipient of the Fernand J. Prevost Mathematics Teaching Award is Nathan Bracy.

Our awardee is a teacher from Goffstown High School who has worked as a paraprofessional,



Ferd Prevost presents the plaque to Nathan Bracy at the NHTM Spring Meeting in Concord., March 25, 2015.

taught 8th grade mathematics, Algebra 2 and Applied Algebra 2. From the very beginning this individual demonstrated an impressive work ethic and a collegial approach to working with Special Education teachers and staff. This teacher is recognized as having the core belief that all students can learn and has innate intuition as to the unique learning needs of individual students. The classroom environment set forth by this individual is noted as one where students are willing to take risks, actively participate and demonstrate improved performance. The reason for this is the strong rapport and unique ability to make teaching and learning fun through engaging, relevant and connected math lessons. Colleagues and staff praise this individual on his ability to use technology to support student learning as well as his creativity in creating Dan Meyer's style lessons to inspire. This teacher is recognized and valued as making a positive impact on his school through his collaboration and leadership skills within various departments in the building.

We are pleased to honor Nathan Bracy as a finalist for the Fernand J. Prevost Mathematics Teaching Award for 2015.

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Superchi Receives Balomenos Memorial Award

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Richard H. Balomenos Memorial Award

Citation read by Rich Andrusiak, 2014 Balomenos recipient and NHTM Post-Secondary Representative

Hello. I'm Rich Andrusiak. As the most recent recipient of the Richard H. Balomenos award, it is my pleasure to explain the award and announce this year's recipient. I was truly honored and grateful to receive the award last year. Thank you to the New Hampshire Teachers of Mathematics.

The Richard H. Balomenos Memorial Award was established by the Executive Board of NH-ATMNE in 1987, to remember and honor a former colleague, educator, and friend. Richard Balomenos and his wife, Georgia, 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 on mathematics education in the state of New Hampshire. The 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.

This year's recipient is a veteran mathematics educator who has shaped mathematics education for more than twenty years in New Hampshire at the elementary, middle, secondary, and post-secondary levels. This award-winning educator has presented at national, regional, and numerous state-level conferences. Service at the secondary level includes, but isn't limited to, being a member of the following state-level committees:

NH Department of Education Grade-Span Expectations Writing Team

NHTM and NH Department of Education Competency Writing Committee

Common Core Standards State Feedback Committee

NH Department of Education 7-12 Mathematics Certification Writing Committee

PK-16 Statewide Quantitative Literacy Action Plan

NECAP Test Item Review Committee

NH State Task Force on Mathematics Instruction

Mathematics School Approval Standards

An excerpt from one of the nomination letters reads, "(his) service to NHTM and mathematics in the State is unparalleled." He has served on various NHTM conference committees, including co-chairing the 50th celebration and conference. He has educated teachers through the NH-IMPACT center, his work as an adjunct professor for Plymouth State University teaching a variety of graduate courses, and through the Intel mathematics program. He has served as a facilitator and mentor in an on-line program supporting new teachers. And, he is just as passionate about educating high school students. This SAU #35 full-time secondary mathematics teacher has served his own district through curriculum committees, coaching, and advisory roles.

From the moment that I met this individual, he inspired me to become a better teacher. He is a master of mathematical pedagogy, process standards, and habits of the mind. Over the years, we have had many conversations that impact my instruction. We have spent hours standing in parking lots, after meetings, diagraming our mathematical thoughts in the air and on doors of cars. I'm not sure I've ever admitted to him what a profound impact he has had on me as a mathematics instructor and person. He has had a profound impact on all of us. This person has recently served you and me as president of NHTM, and continues in the role of past-president. As president he advocated for keeping conference costs low for new teachers of mathematics, and at the end of his term brought a proposal to the NHTM executive board to consider free one-year membership for undergraduate students, pre-service teachers, first-year teachers, and experienced teachers in their first year of teaching within New Hampshire. That proposal was passed and has been in place since the beginning of this school year.

It is my sincere pleasure to present this year's Richard H. Balomenos Memorial award to my colleague and friend, Greg Superchi. Congratulations!



Greg Superchi and Rich Andrusiak, 2015 and 2014 Balomenos award recipients.

NH Teacher Nominated for PAEMST

By Terri Magnus

Each year a few teachers are recognized with the Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST). Honorees receive a certificate signed by the president, a trip to Washington DC, and \$10000.

Londonderry Middle School teacher Ann Gaffney, the one mathematics finalist this year from New Hampshire, is hoping to hear from the national committee that she has been selected for this award. Each state in the union has a committee that can recommend up to five teachers in each of mathematics or science per year. The nominees are then forwarded to the national committee who may select up to two teachers in each category from each state.

According to the PAEMST application packet, nominees are expected to demonstrate “deep content knowledge and exemplary pedagogical skills” (appropriate for the grade level they teach) “that result in improved student learning.” Nominations may be initiated by a principal, a teacher, a parent, a student, a member of the general public, or a teacher may self-nominate. The award does not limit itself to teachers with a specific style, method, or philosophy, emphasizing that there is no single correct way to teach.

The award recognizes K-6 teachers and 7-12 teachers in alternating years. As a middle school teacher who teaches in both grade levels, Ann was nominated for the K-6 award, but could have applied for the 7-12 award this year if she had not been selected.

Nominees are expected to provide three letters of recommendation, a video of a single lesson, and a narrative in which they discuss separately each of the Five Dimensions of Outstanding Teaching, namely:

- Mastery of mathematics or science content appropriate to grade level,
- Use of instructional methods and strategies appropriate for students in the class that support learning,
- Effective use of student assessments to evaluate, monitor, and improve student learning,
- Reflective practice and life long learning to improve teaching and student learning, and
- Leadership in education outside the classroom.



Ann Gaffney, center, and other PAEMST finalists were recognized at Fenway Park during the Red Sox Mathematics Education night associated with the NCTM Conference in Boston.

The biggest challenge for Ann was recording the videotaped lesson. Electrical issues and a fire alarm resulted in her having to rely on the final attempt. Nominees may not splice together portions of a lesson and the narrative must focus on the video-taped lesson or a series of lessons relative to it. In her lesson, Ann had students create and classify comparisons of the lengths of pictured worms. A rich discussion ensued as students were trying to determine whether a ratio fell into the category of additive or multiplicative comparisons. The fact that division can be thought of as repeated subtraction led to a need for deeper understanding.

In addition to teaching at Londonderry, Ann earned her Ed.D. from Rivier University in 2014, co-taught an Intel Mathematics course for two summers, has taught courses at Rivier University and Southern New Hampshire University, and co-presented at the NCTM 2015 National Conference.

Ann hopes other teachers in New Hampshire will nominate themselves or their colleagues for the PAEMST. “There are a lot of deserving people out there who don’t give themselves credit. You don’t have to be perfect to deserve it,” she said adding, “Nobody’s perfect.” Nominations for K-6 teachers will begin again in the fall with a deadline of April 1. Grade 7-12 teachers may be nominated in Fall 2016.

Introduction to Differential Equations – The Learning Curve

Rich Andrusiak, NHTM Post-Secondary Representative

This learning curve activity is adapted from an example presented in the Hughes-Hallett calculus text¹ as an introduction to differential equations. I've adapted that introduction to a mini-activity which results in graphical, numerical, and analytical solutions, along with a discussion of limitations and a preview of slope fields and Euler's method.

The main objectives of the lesson are to:

- Determine what a differential equation is, what constitutes a family of solutions, and why differential equations are useful;
- Determine the role of initial conditions and arbitrary constants in solutions; and
- Determine if a particular function is a solution to a differential equation.

In this activity, you will study the learning curve. Suppose $y\%$ is the percentage of a task that has already been mastered by an employee and t measures time. Then, $\frac{dy}{dt}$ is the rate of change of the percent of the task that is mastered over time. In other words, we can think of $\frac{dy}{dt}$ as the rate at which the person learns.

1. Do you think that $\frac{dy}{dt}$ is increasing or decreasing? Explain.
2. Based on number 1, sketch graphs of y (as a percent) as a function of time in each of the following situations:
 - a. The person starts learning at time $t = 0$ and continues until he or she masters 100% of the task;
 - b. The person starts learning at a later time (than the person in part a) but eventually masters 100% of the task;
 - c. The person starts learning at $t = 0$ but never masters 100% of the task.
3. To describe how the person learns, more precisely, we need to know how the rate the person learns depends on the percent of the task mastered. Suppose that t is measured in weeks and the rate at which the person learns is equal to the percent of the task that is not mastered yet. Use this information to set up a differential equation modeling this situation.

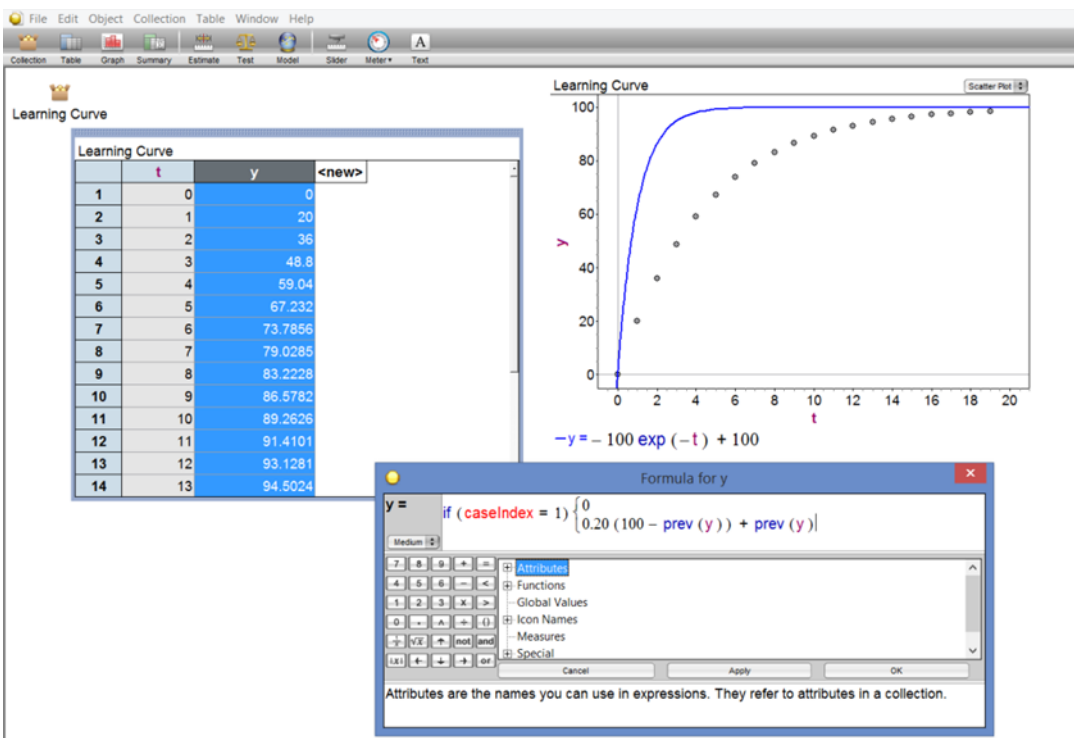
Adapted from Hughes-Hallett, D., McCallum, W.G., & Gleason, A.M., et al. (2013). *Calculus – Single Variable* (6th ed.). Hoboken, NJ: John Wiley & Sons, Inc.

4. Suppose the person begins learning at time $t = 0$ and learns at a rate of 100% per week. So, $\frac{dy}{dt} = 100\%$. If the person continued learning at this rate, he or she would master the entire task in one week. However, as you explained in problem 1, the rate at which the person learns is decreasing over time. Let's assume the person works a five-day work-week and the 100% learning rate holds for the entire first day (in reality, this probably is not the case). So, by the end of day 1, the person has mastered 20% (i.e., $(1/5)(100\%)$) of the task. So, at the end of the first day, the rate at which the person learns is now reduced to 80% per week, or $\frac{dy}{dt} = 80\%$. So, by the end of day 2, the person has learned another 16% (i.e., $(1/5)(80\%)$) and now knows 20% + 16% or 36% of the task. Continue this logic to fill in the missing values in the table below.

| t (in days) | 0 | 1 | 2 | 3 | 4 | 5 | 10 | 20 |
|--------------------------|---|----|----|---|---|---|----|----|
| y (percentage learned) | 0 | 20 | 36 | | | | | |

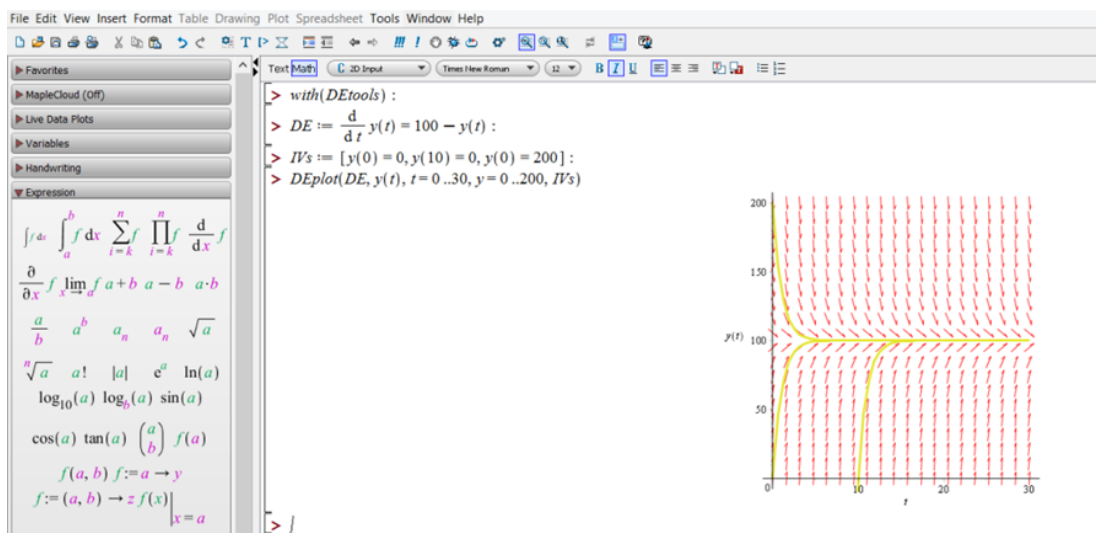
5. Create a scatterplot of the data from your table.

Students typically create the table using a recursive formula in Fathom. We also use the separation of variables technique to find the particular solution where $y(0) = 0$. Students compare the numerical solution to the analytical solution.



Adapted from Hughes-Hallett, D., McCallum, W.G., & Gleason, A.M., et al. (2013). *Calculus – Single Variable* (6th ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Students also use Maple to graph several members of the family of solutions, together with the slope field.



The activity discussion results in the following questions which preview upcoming lessons.

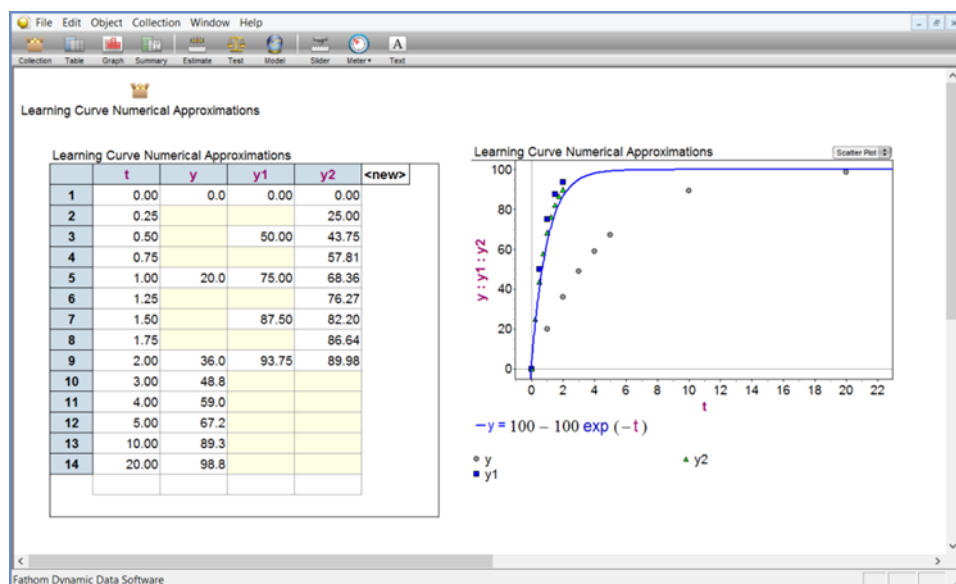
What are some limitations of the model?

Why did our numerical solution not match our analytical solution and how do we improve our numerical solution?

What is a slope field, how are they constructed, and why are they useful?

Why did the analytical method work? (i.e., justification of separation of variables)

We revisit this example when studying Euler's method and improve our numerical approximation.



If you have any questions regarding this activity, please contact me at randrusiak@ccsnh.edu.

Adapted from Hughes-Hallett, D., McCallum, W.G., & Gleason, A.M., et al. (2013). *Calculus – Single Variable* (6th ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Post-Secondary Representative

Summer Opportunities & Program Updates

By Rich Andrusiak

Here are some summer opportunities and program updates from around the state.

Community College System of New Hampshire

STEM Program Updates

Over the past few academic years many of the community colleges, including River Valley Community College, NHTI, Manchester Community College, and Nashua Community College have added degree programs that include concentrations in STEM fields such as mathematics, engineering, biological science, and physical science. The University System of NH and the Community College System of NH are working together to establish clear course equivalencies and future 2+2 agreements which will result in seamless transfer between the two institutions. To learn more about STEM studies at the community colleges, go to: <http://www.ccsnh.edu/academics/stem-studies-science-technology-engineering-math>.

Community College to College of Engineering & Physical Science (CC2CEPS) Transfer Program & Scholarship

UNH assistant professors of chemistry Sam Pazicni and Meg Greenslade received a \$630,000 grant from the National Science Foundation to provide opportunities for scholarships for transfer students from the community college system to the University of New Hampshire supporting studies in engineering, computer science, physical science, or mathematics. To read more, go here: <http://www.unh.edu/news/releases/2015/03/em19stemgrant.cfm>.

Plymouth State University

PSU Graduate Mathematics Education Course

MG 5860: Functions and Modeling for Middle/Secondary School Teachers (4 Credits)
Professor Osama Taani

Offered at PSU Concord – 2 Pillsbury Street

August 5, 6, 7, 10, 11, and 12 from 9:00 am to 4:00 pm

This course focuses on functions and modeling concepts central to the Common Core State Standards in Mathematics [CCSSM]. The mathematical content of the course aligns with the CCSSM standards (gr. 5 – 12) in functions and modeling. Students will develop conceptual understanding and confidence working with functions and modeling. Activities are designed to demonstrate how the Standards for Mathematical Practice in CCSSM can be integrated in the everyday learning experiences of every student. Class discussions are centered on thinking processes, habits of mind, conceptual understanding, and dispositions that students need in order to develop a deep, flexible, and enduring understanding of mathematics.

(Continued on page 14)

Summer Professional Development Opportunities

(Continued from page 13)

University of New Hampshire

STEM Education Summit

UNH Department of Education and the Leitzel Center for Math, Science and Engineering Education are sponsoring the STEM Education Summit on May 30th at the UNH Memorial Union Building. Please check with Ms. Sandy Coit (sandy.cit@unh.edu) for details.

Future Summer Mathematics Courses for Teachers

Beginning summer 2016 we will be offering summer mathematics courses for elementary and middle school teachers.

MST Degree in Mathematics for Secondary and Middle School Teachers

The University of New Hampshire (UNH) offers an MST degree in Mathematics for secondary and middle school teachers. It is possible to earn the degree in two summers through in-class and online coursework. Along with a set of three credit on campus courses focused on various top-

ics in mathematics, two 1-credit online mathematics electives will be offered during early summer (5/26/15 - 6/26/15), and one 1-credit in-class mathematics elective will be offered mid-summer (Monday afternoons, 6/29/15-7/31/15). You need not be an MST student to register for MST courses. Visit www.math.unh.edu/graduate/teach for more information on the MST Program and a complete list of MST courses.

Rivier University

History of Mathematics Graduate Course

MA509 History of Mathematics, a graduate course in mathematics for M.A.T. students and others, is being offered on Monday and Wednesday nights from 6-9 p.m, June 29-August 6. See www.rivier.edu for additional details or contact tmagnus@rivier.edu for course information. The Masters of Arts in Teaching Mathematics degree can be earned through a combination of summer and evening coursework. Students may choose from the option leading to secondary or middle school education or a more flexible non-certification program. To get started in earning this degree, contact dmonico@rivier.edu.

NHTM Raffles Off a Free Registration to NCTM in Boston!

Nanci Plimpton, a 1st grade teacher at Salisbury Elementary School (SES) in Salisbury, NH won a free registration to the NCTM National Conference in Boston, MA in April. Nanci won the complimentary registration at an NHTM Regional Event she attended held at Merrimack Valley Middle School in January. On April 16th, 17th and 18th, Nanci attended the NCTM Conference with three colleagues from the Merrimack Valley School District (MVSD). For three of the four MVSD attendees, it was their first national conference and by all accounts, it was fantastic!

Nanci and her colleagues came back to school on Monday, April 20th reinvigorated with new manipulatives in hand and eyes on next year's national conference in San Francisco, CA. Nanci is sharing her new-found knowledge and manipulatives with her colleagues.

Elementary Representative

Changing of the Guards

By Stephanie Wheeler

As this is my last column as NHTM's Elementary Representative, I would like to take the opportunity to express my gratitude for letting me serve on the board for the past six years. My time on the NHTM Board has granted me professional growth and opportunities, as well as professional connections and many trusted, valued personal relationships. I have had the pleasure of working with, for and under all of the most respected and admired mathematics educational leaders in New Hampshire.

Looking back, I remember the first time I ran for a position on the board, I ran against Betty Erickson for the position of ATMNE Representative. I lost of course – I mean I was running against the Great Betty Erickson! However, within a year, the Elementary Representative position opened up and I was elected. I only mention this because I was very hesitant to run the second time after having lost the first time I ran. But I'm so glad I decided to run again! Being a member of the NHTM Board has not only been an honor and a privilege, it has allowed me a front row seat to all the changes and happenings in mathematics education in New Hampshire and beyond.

So in my last column, I put a plug in for your active participation in NHTM in the future. In fact your active participation can take many different forms, including:

- ◇ Running for a position on the NHTM Board,
- ◇ Taking a leadership role in or volunteering at an NHTM sponsored Conference or Event,
- ◇ Helping with the NHTM Annual Spring Conference, the NHTM Annual Dine and Discuss, or NHTM Regional Events, and
- ◇ Actively seeking and recognizing colleagues for one of NHTM's Annual Awards: The Richard H. Balamenos Memorial Award, The Richard C. Evans Distinguished Mathematics Educator Award, or The Fernand J. Prevost Mathematics Teaching Award

My time on the board has truly been a learning, collaborative experience that has enhanced my work as a mathematics educator, and now my work as an administrator at the elementary level. I wish Amy Gregoire all the best as she takes over the reins as NHTM's Elementary Representative.

Mathesis: One Editor but Many Contributors

By Terri Magnus

This will be my last edition of the NHTM *Mathesis*. When I took on this position in August 2010, we were still printing the newsletter in booklet form and sending it bulk mail. At the time, I relied on the previous editor Dave Kent and the staff at PSU to help “pony express” the newsletter to all of you! The transition to an electronic newsletter provided plenty of challenges, some fun to conquer and some of which are yet to be solved. It has been a great experience.

I have many people to thank. Judy Curran Buck was my editor behind the scenes, proofreading every edition in fine detail. Each of the NHTM Presidents, Judy, Greg Superchi, and now Cecile Carlton helped me make decisions as to what belonged in the newsletter and overcome some of the challenges. Matt Treamer figured out how to post the newsletter on the NHTM website and distribute it to all the membership which he continues to do each quarter. I also want to thank the many people who have sent me news, columns, or photos over the years, especially Art Johnson, the NHTM presidents, and the NHTM grade level representatives. Finally, I would like to thank you for electing me as NCTM Representative. I am thrilled to continue serving on the NHTM Board and look forward to my new role.

The NHTM Executive Board will need to appoint a new editor at its meeting on May 28. I wish the new editor well and look forward to seeing how the *Mathesis* continues to evolve over the years.

NCTM News:

Rockin' with the Math Stars in Boston

By Annie Wallace

Here in New England, the snow melted and it got just warm enough to welcome nearly 10,000 people to Boston for the 2015 NCTM Annual Meeting and Exposition to share ideas and network about effective mathematics teaching and learning. There were over 700 presentations to choose from, sure to guarantee something of interest for everyone. My friends and colleagues who attended had a good time and are still talking about the workshops they attended and what they are using and implementing into their classes. The conversations and sharing are wonderful!

Diane Briars, President of NCTM, in speaking to the affiliate representatives gave an overview of the activities that NCTM has been involved in over the past year in supporting quality mathematics education for every student. These included critical issues in:

ESEA Reauthorization: Having dedicated funds to support mathematical professional development, assess all aspects of mathematical learning, include performance assessments, and that there is a mechanism for ensuring comparable quality assessments across states.

Curriculum Materials reviews: should support student learning through the standards, support enactment of effective teaching practices, reviews should focus on the nature and organization of the mathematical learning experiences, and to recognize that no materials are perfect, but to recognize the flaws that can be corrected and the ones that cannot.

Guidelines for Mathematical Modeling: This is as a joint NCTM/SIAM committee on modeling across the curriculum which is expected to be released in April of 2016 as the *APME Mathematical Modeling and Modeling Mathematics*, and

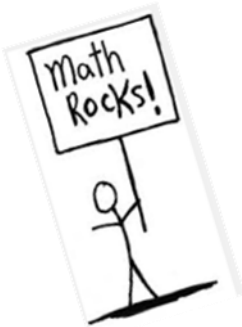
NCTM as an Equity Organization: NCTM is establishing a process to promote diversity among NCTM leaders and emerging leaders.

Currently, you can find some webcasts of conference highlights at <http://www.nctm.org/Conferences-and-Professional-Development/Annual-Meeting-and-Exposition/Conference-Highlights/>.

NCTM and the Hunt Institute have produced a series of videos on Teaching and Learning Mathematics with the Common Core to enhance understanding of the mathematics that that students need to succeed in college, life, and careers. Although the videos were developed with parents as the primary audience, they are also good for us, as educators, to use a resource. These can be found at <http://www.nctm.org/CCSSMvideos/>.

A reminder that NCTM offers several grants and scholarships. These, along with their application deadlines can be found at <http://www.nctm.org/Grants/>

I hope that many of you were able to attend the NCTM Meeting and Exposition in Boston. I had a wonderful time and got to see many friends and associates and was able to meet many more people from all over the country and world, along with gaining an opportunity to see and learn from many inspirational people. As I told my students, this was my chance to go to a premier mathematics rock concert and get to see and meet many of my mathematical 'rock-star' idols! – My friends and I even got our picture taken with Dan Meyer!!!



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Middle Level Representative

Letting Go

By Katrina Hall

As one looks back on 2014-2015 year in math class, there were standards covered in depth, standards that spiraled throughout the year, and some that were quickly covered in the final days. There was homework, classwork and discussions. And of course, one cannot forget the quizzes, tests and projects. It is surely safe to say, that teachers could reflect on this year and see a year filled with teaching and learning. The best teachers, however, do not stop here. The best teachers take this time to reflect at a deeper level.

Opening the door of a typical math classroom, more likely than not one will see the room lined with bookshelves, file cabinets, and computers. On the bookshelf, there are stacks upon stacks of mathematically-based books. Opening the file cabinet, one finds folders full of mathematical fun. Inside the desk drawers or within the folders of the computer, there are rubrics and assessments. All the instruction from the year is organized and structured for learning.

This past year I had taught at a different level. This change made me realize that all of my structure and organization was nothing more than that. For the 2014-2015 school year, I needed to start over. The natural and easy thing to do was to find the traditional worksheets, use the problems from the textbook, and assess with premade quizzes or tests. However, I opted to take an alternative route. I challenged myself to bring STEM, collaboration, innovation, technology and creativity into the math classroom.

Looking back over the year, there is always the good and the bad. However, when looking back the good parts for the 2014-2015 year, all the good included the characteristics set forth in my challenge. The key to this? Letting go. The best learning occurred in the classroom when students were given the open-ended and non-traditional experiences. No more did I hear the question "Is this right?" from students. Instead they asked, "Can we try this?"

This is not to say that everyday was the perfect math lesson. There were certainly days where I took the traditional and easy route; or at least what I thought was the easy route. In reality I found that the less structure and pre-organization I put into a lesson, the easier it was for me to plan.

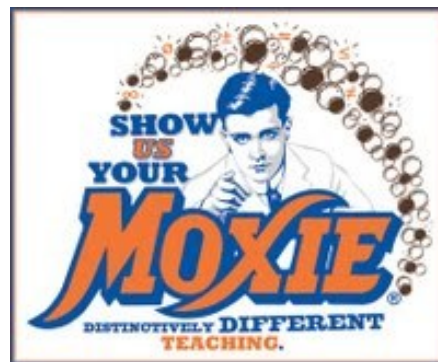
As the year comes to a close, what does teaching and learning math look like in your classroom? What will your teaching and learning look like in 2015-2016? Consider starting fresh next year. Try letting go.

Sorry you missed NCTM Boston? ... Or maybe you attended NCTM and are eager for more? Be sure to make plans to attend the upcoming ATMNE Fall Conference hosted by ATOMIM (Association of Teachers of Mathematics in Maine).

October 29-30 in Portland ME

Featuring Keynote Speakers:
Don Balka, Past-President of TODOS
Diane Briars, President of NCTM
Dan Meyer and Greg Tang

Visit <https://sites.google.com/site/atmne2015/> for more information.



Results of the New Hampshire High School Mathematics Contest

By Steve Latvis

Our 43rd annual State Mathematics Contest was held Tuesday, March 17, 2015. Despite the early morning weather setbacks the meet ran relatively smoothly. Students and advisors made the trek from their institutions to Plymouth State University for the competition. Of the 53 schools that registered for the competition we had 51 compete this year (1 team was a last minute cancellation and 1 team could not make it due to the weather).

We extend our congratulations to our outstanding performers, to our winning teams and advisors in each division. High praise is due to Kellie Gabriel and her Nashua High School **South** team (from the Large school division) for their performance in achieving a score of 291 points out of a possible 432 points. Rounding out the first place schools by division: Hanover High School in the Intermediate school division earned a score of 289 points, Bishop Brady in the Small school division earned a score of 255, and Plymouth Regional High School earned a score of 241. Bravo! Three students achieved a perfect score of

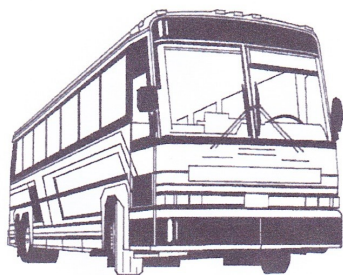
36 points this year. – juniors Justin Chen (from Hanover High School) and Jewelina Durant (from Oyster River High School); and sophomore Connor Lennox (from Winnacunnet High School).



Our sincere thanks for the contributions all of you made to the contest by performing your duties so well. Many of you did other tasks before, during, and after the contest that assisted in getting the details accomplished. Our special thanks to

those who were able to accommodate our needs at the site – Professors Shawn Hackshaw and John Donovan of the PSU Math Department and Jennifer Smith, Coordinator of Activities at the Hartman Union Building; to Donna Kelley and her team of question writers; to Kellie Gabriel for heading up registration; to the chairpersons of all the various duties on contest day – Jim Brizard, Ellen Berchtold, Greg Morris, Lorainne Mascioli, Sue Capano and Michelle Morton-Curit; to “team refreshments committee” for helping me with the food for the coaches; and to any others I may have missed who assisted myself and others attending to the small details on the day itself.





New York City Math Field Trip

Make your reservations now!

Join us for an overnight trip to New York City...

A Mathematics Field Trip for teachers and friends.

We will need to have 40 people on the trip to guarantee the great price – open to NHTM members and non-members. First come – first served.

*Ten paid reservations required by **May 23, 2015** and all 40 paid by **June 25th**, 2015 to make this happen!*

Dates of Travel: July 23-24, 2015

Costs \$230 Covers room, coach, MoMath ticket and trip bag portorage.

[A block of 20 rooms with double beds have been reserved, you'll need a roommate to receive this rate.]

Depart NH: 7:00 AM New London—one stop in Concord NH

[Details will be sent w/paid registration and as we get closer to departure date.]

Reserve tickets on your own for theater on Thursday evening or visit the TKS office that afternoon for discounts on various plays for that evening.

Friday on your own with departure from NYC at 4PM

Register on line at www.nhmathteachers.org
Payment needs to be made at time of registration.....



Museum of Mathematics

MoMath.org

**11 East 26th Street
New York, NY 10010
(212) 542-0566
info@momath.org
Open 7 days a week
10AM – 5 PM**

Offered through NHTM



From the desk of the Membership Chair...

Congratulations to Kathy Fowler who received the NHTM 25 Year Math Educator Award at our Spring Dinner Meeting.

Currently we have 19 teachers who have accepted our 1-year FREE NHTM membership offer. Please continue to spread the word about our free one-year NHTM memberships available to undergraduate students, pre-service teachers, first year teachers, PreK-6 teachers who have not held a NHTM (or NHJEM) membership previously, and experienced teachers in their first year of teaching within New Hampshire.

As of May 2015 our membership is at 317. Thank you for your membership renewals! With our online registration you now have the ability to renew your membership online, check your membership status, and update your personal contact information. Just go to www.nhmathteachers.org and login with your email address. Feel free to email Gretchen.Scruton@gmail.com with any questions. PO's and membership renewals paid by check may be mailed to the following address:

Gretchen Scruton, NHTM Membership

195 Ten Rod Road

Rochester, NH 03867

Newsbytes...Newsbytes...Newsbytes...Newsbytes...Newsbytes...

- The Mathematics Learning Communities Project is pleased to announce an upcoming professional development event to be held on Saturday, June 6, 2015 at NHTI in Concord, NH, focusing on the teaching of course content -- for both the Senior Math and Topics in Applied College Mathematics (TAC.Math) courses -- utilizing both the Habits of Mind Critical Thinking Skills and applied problem solving techniques. The sessions will include activities from the course instructor guides, mathematical problem solving, CCSSM alignment. Keynote speaker, Joseph Spadano, Rivier University, will be presenting "Advancing Mathematical Power.". High school teachers who are teaching or planning to teach one of these courses as well as community college instructors or learning center staff who are associated with developmental mathematics courses are encouraged to apply. There is no fee for the workshop which includes lunch, a stipend, and a travel reimbursement, but applications are due May 25 and space is limited. Please direct all inquiries to: Debbie Payne, co-coordinator of Two-Tier Strategy Instructor's Workshop, dpayne@sau57.org, 603-560-0227. Funding for the MLC Instructor's Workshop is provided by the NH Department of Education's Math Science Partnership Grant.
- In support of the eight recommendations in the New Hampshire STEM Taskforce report STEM initiative, *Pathways to STEM Excellence: Inspiring Students, Empowering Teachers, and Raising Standards* (<http://www.governor.nh.gov/commissions-task-forces/stem/index.htm>), Southern New Hampshire University is hosting a **Texas Instruments Summer Workshop on August 12-14** three-day STEM workshop titled, "**Getting Started with TI-Nspire™ Technology in Connecting Science & Mathematics**". The workshop will provide middle school, high school, college and pre-service math and science teachers hands-on experience with simulations and data collection activities that can be integrated into their classrooms. Workshop registration is \$350 per person (discounts available for pre-service teachers) and includes a TI-Nspire™ and teacher software. Visit <http://education.ti.com/en/us/professional-development/summer-workshops> to register. For additional information, contact Professor Pamela Cohen at p.cohen@snhu.edu
- SAU21, in collaboration with the UNH College of Engineering and Physical Sciences, and the NH Southeastern Curriculum, Instruction, & Assessment Team, presents "**The Mindset Revolution: How to Teach for a Growth Mindset and Drastically Increase Math Achievement for K-8 Students,**" presented by **Jo Boaler** on Friday, August 28, 2015 at the Liberty Lane Conference Center. The cost is \$100 per person and teams of 4 or 8 teachers will be given priority. Register by visiting the website https://www.surveymonkey.com/s/Boaler_August28. For more information, check the SAU21.org website or e-mail pkennedy@sau21.org.
- Show your support for the New Hampshire Teachers of Mathematics organization. Apparel and accessories embroidered with the NHTM logo may be purchased via <http://nhtm4all.qbstores.com/>.

NHTM Executive Board

Officers

| | | |
|-------------------------|--|--|
| <u>President</u> | Cecile Carlton, Mathematics Consultant | cecile.carlton@comcast.net |
| <u>Secretary</u> | Andrea Drake, Oyster River High School | adrake@orcsd.org |
| <u>Treasurer</u> | Kellie Gabriel, Nashua High School South | kgab@comcast.net |

Council

| | | |
|--|---|--|
| <u>Elementary School Rep</u> | Stephanie Wheeler, Salisbury and Webster Elementary School Principal, Merrimack Valley School District | slwheeler3@aol.com |
| <u>Middle Levels Rep</u> | Katrina Hall, Hollis Brookline Middle School | katrinaleighhall@gmail.com |
| <u>Secondary Representative</u> | Michelle Fox, Groveton High School | m_fox@sau58.org |
| <u>Post-Secondary Rep</u> | Richard Andrusiak, Dept of Mathematics, River Valley CC | randrusiak@ccsnh.edu |
| <u>Past-President</u> | Greg Superchi, Lisbon Regional School | gsuperchi@yahoo.com |
| <u>School Administrative Rep</u> | Donald R. West, Kearsarge Regional School District | dwest@kearsearge.org |
| <u>ATMNE Representative</u> | Rob Lukasiak, Mathematics Consulting Services | rlukasiak@comcast.net |
| <u>NCTM Representative</u> | Annie Wallace, Hampstead Middle School | anniekwallace@hotmail.com |
| <u>Membership Committee Chair</u> | Gretchen Scruton, Timberlane Middle School | gretchen.scruton@gmail.com |
| <u>Newsletter Editor</u> | Teresa Magnus, Dept. of Math & Comp Sci, Rivier University | tmagnus@rivier.edu |
| <u>Media & Public Relations</u> | Amanda Barton, Sunapee Middle High School | benwarea@gmail.com |
| <u>Historian</u> | David G. Kent, Hopkinton High School (Retired) | dg_kent@mcttelecom.com |
| <u>Webmaster</u> | Matt Treamer, NCED Services | matt@ncedservices.org |

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

Professional Development and Conferences

National

| | | |
|---------------------------------------|------------------|---------------------|
| MAA Mathfest | Washington DC | 5-8 August 2015 |
| AMATYC 41st Annual Conference | New Orleans LA | 19-22 November 2015 |
| Joint Mathematics Meetings | Seattle WA | 6-9 January 2016 |
| T ³ Annual Conference | Orlando FL | 26-28 February 2016 |
| ICTCM 28th Annual Conference | Atlanta GA | 10-13 March 2016 |
| NCSM 48th Annual Conference | San Francisco CA | 11-13 April 2016 |
| NCTM 94th Annual Meeting & Exposition | San Francisco CA | 13-16 April 2016 |

State & Regional

| | | |
|---------------------------------------|------------------|--------------------|
| NCTM Regional Meeting | Atlantic City NJ | 21-23 October 2015 |
| ATMNE Fall Conference | Portland ME | 29-30 October 2015 |
| NHTM Spring Meeting | Manchester NH | March 2016 |
| 44th Annual State Mathematics Contest | Plymouth NH | March 2016 |
| ATMNE Fall Conference | Manchester NH | 20-21 October 2016 |

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 shall be to provide vision and leadership in improving the teaching and learning of mathematics so that each student is ensured quality mathematics education and each teacher of mathematics is ensured the opportunity to grow professionally.