April 2008

Mathbits

2008 Minnesota Spring Mathematics Conference

DECC, Duluth, MN · Friday, April 25 & Saturday, April 26

The Minnesota Council of Teachers of Mathematics
and Minnesota Mathematics Association of Two-Year Colleges

Inside this issue:

A+ in MATHEMATICS: Algebra and Much More

Explore these opportunities for engagement in mathematics and mathematics education at the spring conference:

- Many sessions for Pre-K through post secondary level teachers.
- Keynote speakers:
  Kim Sutton and Susan Vass (*see MCTM website or February Mathbits for brief bios*)
- Networking with other teachers during the Friday MCTM reception.
- Special sessions for new teachers and preservice teachers.
- Be part of the future of MCTM by attending the annual Delegate Assembly. Contact your District Director to see how you can get involved.

Thursday Registration and exhibits open 7:00 - 9:00 pm.
Friday Exhibits open and registration 7:30 am. Sessions start at 8:40 am and end at 5:45 pm, with hors d'ouevres to follow.
Saturday Exhibits open and registration 7:30 am. Sessions 8:15 am - 12:45 pm with closing lunch and keynote speaker to follow.

Sampling of Conference Sessions

General Interest

Math Literacy Readiness and Post-Secondary Success
MCA-III Test Specifications are in Draft form!
Strategies to help in the first years of teaching

PreK-2 Interest Level

Where's the Data – It's In Primary!
Take a Chance? Exploring Probability in the Primary Classroom
Teaching Computational Fluency: Daily routines to Develop Number Sense and Fluency, and Learn Facts

3-5 Interest Level

Exploring Area and Perimeter With Pentominoes
The Link Between Arithmetic and Algebra in the Elementary Classroom
Reading Comprehension & Vocabulary Development in Math
Algebraic Thinking, Multiplication & Division
Implementing CGI Philosophy in Daily Mathematics Instruction
Create Mathematical Coherence for K – 8 Students Using Model Drawings

(Continued on page 5)

President's Message

Judy Stucki
judy@stucki.us

Every now and then we have a magic moment in class that makes us feel like we are making a difference. In my Math for Elementary Teachers class we have recently completed the unit on probability. One of the older students with elementary age children came in the other day so very excited. Her son had come home with the assignment to take four different digits and rearrange them into as many different numbers as possible. She was so excited that she could explain to him why she knew that he had found them all. It takes so little to excite us. If our students only knew what a comment like this does for us!

This summer we will again be running our Committee Fest where we start the work directed by the membership at the delegate assembly during the spring conference. If you are attending the spring conference you will have an opportunity to sign up for a committee. If you are not able to attend and would like to serve on one of the following committees, please email me your choice.

MCTM Committees:

Professional Concerns	Technology
Membership	Teacher Incentive Grants
Publicity	Legislative
Professional Partnerships	Write an article for Mathbits
Spring Conference	Fall Conference

Thank you for you commitment to your students and the math teachers of MN.

District Meetings and Delegate Assembly 2008

Be a delegate! Contact your district director.

District Meetings will be held at the Spring Conference on Friday following the final afternoon sessions. The program book will list exact meeting locations for each district. Please come and join your district meeting to share your ideas and concerns. We will be asking for resolutions to be considered at the evening delegate assembly. All members are encouraged to attend. Each district will hold a drawing for a Gift Certificate redeemable for NCTM or MCTM materials and attendees will receive a free drink ticket for the evening reception.

The annual **Delegate Assembly** will be held Friday evening at 7:30 pm. Delegates will discuss resolutions presented at the district meetings and will vote on new resolutions for MCTM. A dessert buffet along with coffee and tea will be provided. All delegates in attendance will receive a Gift Certificate to use at the NCTM/MCTM materials booth in the exhibit hall at the Spring Conference.

Each of the eight MCTM district directors is eager to effectively represent mathematics teachers in their respective districts. One of the directors' main goals is to improve communication between the MCTM board and the MCTM membership. We want to know of questions and concerns teachers may have concerning math standards, assessment issues, types of curriculum and its use, etc. Please feel free to contact us at anytime. Each district director's current email address is listed on the website. If you are unsure which MCTM district your school is in, this information is also available on the MCTM website.

MCTM Foundation

Your $$ Needed—Support the MCTM Foundation

The MCTM Foundation has an endowment fund whose investment returns are used to support activities that promote continued excellence in mathematics education in Minnesota. During the spring conference, the MCTM Foundation will have a table in the DECC exhibit hall. Stop by to visit with members of the Foundation Governing Board. Get acquainted with this year's recipients of Foundation grants for conference participation. Find out how your contribution will be significant for the long-term advancement of mathematics education in Minnesota. Everyone can be a Foundation donor.

1. Math Specialist
   Be it resolved that MCTM contact the MDE commissioner's office to request that the state fill the math specialist position.

Action Taken: The MCTM President will send a letter to the commissioner. (4/29/07)
The letter was written and sent. (6/19/07)
The position has been filled. (9/15/07)
COMPLETED 9/15/07

2. Standards
   Be it resolved that MCTM encourage its membership to contact their legislators asking them to financially support professional development and implementation of the new math standards (e.g., math and science teaching centers across the state).

Action Taken: Refer this resolution to the Professional Concerns and Legislative Task Force. (4/29/07)
The Legislative Task Force met to develop action items to address this resolution. The Professional Concerns Committee supports the plan of the Legislative Task Force. (6/19/07)
The MCTM president will contact the chair of the Legislative Task Force to get an update on the action items. (9/15/07)
The state legislature is developing math academies for professional development on implementing the new math standards. (12/1/07)
COMPLETED 12/1/07

3. Arnie Cutler
   Be it resolved that MCTM find a means for honoring Arnie Cutler's service to mathematics education and the MCTM.

Action Taken: Refer this resolution to both the Executive Committee and the Foundation Board. (4/29/07)
The Foundation Board recommends that one of its mid-career scholarships be called the Arnie Cutler Award, pending approval of the Cutler family. (6/19/07)
The Cutler family has given its approval and the scholarship will be called the Arnie Cutler Scholarship. (12/1/07)
COMPLETED 12/1/07

4. Communications
   Be it resolved that MCTM study the possibility of improving communication, (e.g., through e-mail, delivering *Mathbits* electronically).

Action Taken: Refer this resolution to both the Membership and Publicity committees. (4/29/07)
The Publicity Committee will send out a mass mailing approximately every 6 weeks to inform membership of new and important items. The Publicity Committee will submit an article to *Mathbits* to explain this procedure and to ask for email address corrections. The Membership Committee is considering some proposals to submit to the Board of Directors. (6/19/07)
The article for *Mathbits* is in the September issue. A mass mailing went out in early September. The Membership Committee presented a list of proposals to the board. The board requested that a financial analysis of those proposals be conducted. (9/15/07)
The Publicity Committee's portion of the work is COMPLETED. (12/1/07)
The Membership Committee decided to withdraw their proposals due to the logistical difficulties that would be associated with their implementation. (2/2/08)
COMPLETED 2/2/08

(Continued on page 4)

Report on Spring 2007 Delegate Assembly Resolutions

Resolutions that were assigned to committees were initially addressed by the assigned committees during MCTM Committee Fest on June 19, 2007.

If you have ideas, concerns, or if you are interested in serving the organization on a committee, contact your district director. Take the opportunity to visit with your district director at the Spring Conference; your district director will appreciate the initiative. To determine which district you are in and the director's contact information, visit the MCTM website.

5. Licensing
   Be it resolved that MCTM prepare a position paper on the licensing of K-12 math teachers.

Action Taken: The resolution will be referred to the Professional Concerns committee for study. (4/29/07)
The Professional Concerns Committee will gather information on licensure issues across the state. (6/19/07)
The information gathering is in process. (9/15/07)
There will be an update at the February board meeting. (12/1/07)
The Professional Concerns Committee reported that licensure falls under the State Board of Teaching. At this time, the Department of Education is considering a change to licensure (possibly having a K-6 teaching license and then have the specialization be a minor in a subject). There are added complexities for charter schools, which may make greater use of "community experts" who do not hold a regular teaching license in mathematics, and private schools which do not fall under the public licensing requirements.
In light of the existing complexity in the licensure process and the changes under discussion, the Professional Concerns Committee requested that the board reject this resolution as it is not feasible at this time. (2/2/07)
Resolution REJECTED 2/2/07

#6 Conferences
Be it resolved that MCTM investigate appropriate ways to make conference material available on the web site.

Action Taken: The resolution will be referred to the Fall and Spring Conference Committees. (4/29/07)
The Spring Conference Committee felt that in principle providing a list of speakers' emails would be a good idea. The Fall Conference Committee suggests that presenters' email addresses be placed in the program book, providing the speaker provides that information. (6/19/07)
The Spring Conference Committee is looking into logistic issues with putting the email addresses in the program book. Email addresses will be in the fall conference program book. (9/15/07)
The Fall Conference portion is COMPLETED. (12/1/07)
The Spring Conference Committee said there is not enough room in the program book to include emails, but if feasible, a separate insert of emails might be provided in the program packet or the website. (12/1/07)
COMPLETED 12/1

Special Events in Conjunction with the 2008 Spring Conference

Tenth Symposium on Mathematics Education
"Algebra for All: What does this mean for Minnesota Schools?"
Guest speaker: Don Balka—grade band break out sessions
Thursday, April 24, 2008 — Duluth Entertainment and Convention Center – Duluth, MN

CONNECT Welcome Session—for new and future teachers
Thursday, April 24, 7:00-9:00 PM at the DECC in Duluth
Immediately preceding the joint MCTM/MinnMATYC Spring Conference
Soup, sandwiches, pop and dessert provided * Free teaching materials & ideas
Fun activities, fun people * Discover how to get your own personal mentor

More information and contacts to answer further questions found on the MCTM website.

Assessment Committees

All questions on Minnesota assessments are reviewed multiple times by committees of Minnesota teachers. The committees meet throughout the year but a majority of the meetings take place during the summer. These committees provide an opportunity for teachers to discuss the standards and have a better understanding of Minnesota's assessments.

All participants are reimbursed within guidelines for travel and meals (lodging, if necessary). During the summer, school employees not under contract receive the $125/day honorarium. During the school year, a school is reimbursed for substitute costs for a teacher serving on a panel. The process for applying to be on a panel begins with submitting your name to the Advisory Panel Register.
http://education.state.mn.us/MDE/Accountability_Programs/Assessment_and_Testing/Professional_Development/Advisory_Panels/index.html

Teachers in the database who qualify for participation on a particular panel are put into an eligible pool similar to the process in jury selection. Invitations to panels are based on information in the Register; a random sample of eligible teachers who meet the criteria is invited to each panel. We over-invite to make sure we will have enough acceptances, knowing that the date will not work for everyone. Declining an invitation does not affect your chances of being invited to future meetings.

Our goal for each panel is that members reflect Minnesota's ethnic and geographic diversity and that about half of the members have had previous panel experience. Each panel is a separate entity that meets for a few days and disbands. Accepting an invitation to a panel is not a long-term commitment.

If you have any questions, please contact Jennifer Dugan (651) 582-8654, Sandy Gimpl (651) 582- 8634, or Rosemary Heinitz (651) 582- 8836 at the Minnesota Department of Education.

What's New in Statewide Assessment?

Rosemary Heinitz

Math Content Specialist
MDE Research & Assessment

(Continued from page 1)

6-8 Interest Level
- Math Carnival: A Probability Project
- Making Algebra Meaningful in Grades 5 – 8

6-12 Interest level
- Moving Math Instruction into the 21st Century: Using interactive lessons with SmartBoard
- Angles, Triangles and Venn Diagrams
- Factoring Polynomials: It Doesn't Have to be Difficult
- Improving Student Algebra Achievement Using Algebra Tiles
- What if the Graph is Linear?
- Using Manipulatives and Investigations in Geometry

9-12 Interest Level
- The Newest TI Kid on the Block The TI-Nspire Handheld
- Active Learning Strategies That Work in Algebra and Geometry
- Revisiting Geometric Proof: Strategies for Success
- Engaging Inequalities: Real World Contexts for Exploring the Mathematics of Inequalities

9-College Interest level
- Geometry knowledge in technology: Sketchpad as an assessment tool
- Logarithms: What are they and Who Cares?
- Probing the Depths of a Common Algebra Problem
- High School Math Curricula & College Math Performance

College Interest Level
- What is the ideal math methods course?
- Using Mathematica's Demonstration Project in your Calculus Classroom

Online conference registration and printable registration forms are available on the MCTM website.

Summer 2008 Professional Development and Education Opportunities

Summer Math Offerings at Bemidji State University

Bemidji State University has several opportunities for MN teachers funded with NCLB money through the MN Higher Education Services Office. The courses and dates are:

Data Investigations and Assessment in the Math Classroom for K-8 Teachers
June 9 - June 27, 2008

Patterns and Functions and Discrete Mathematics for K-8 Teachers
June 30 to July 18, 2008

Arithmetic Foundations for Teachers and Paraprofessionals
Arithmetic Foundations I July 21-29, 2008
Arithmetic Foundations II July 31 - Aug 8, 2008.

For additional information and application procedures please see the website:
http://faculty.bemidjistate.edu/grichgels/Eisenhower/SummerAppForm.html

Contacts: Todd, TFrauenholtz@BemidjiState.edu (218) 755-2817
Glen, GRichgels@BemidjiState.edu (218) 755-2824

The Mathematics Within—University of Minnesota

The **Institute of Technology Center for Educational Programs** will offer teacher professional development courses in the summer of 2008. These intensive courses aim to help teachers (grades 3-7) recognize the "language of mathematics," deepen their math content knowledge, and connect new math knowledge not only to a teacher's school curriculum but to the bigger picture of middle school math content. Participants will work with an instructional team to develop concept-specific mathematics enrichment units adaptable for a wide range of student skills, and comprehension levels.

Connections between Algebraic Processes and Geometric Structures
June 16—July 3, 2008

Spend three weeks deepening your mathematical knowledge! The first week will cover algebraic foundations by discussing and exploring topics such as subtraction and negative numbers, fractions, and the Pythagorean Theorem. As participants delve into visual representations and manipulatives that help students (and teachers) struggling to understand difficult but foundational math concepts, they will discover new connections between division, multiplication and addition. During the second week discussions will cover the geometric applications of division and fractions, finding Pythagorean Triples through experimentation, and exploring representational systems for shape, position and movement. Participants will investigate mathematical situations through pattern, symmetry and transformations, and study the characteristics of and relationships between two and three dimensional shapes. The final week will allow participants to work with an instructional team to develop concept-specific mathematics enrichment units adaptable for a wide range of student skills, comprehension and experiences. These materials will be aligned with the state and national standards for grades 3–7 mathematics curricula.

Tuition and fees as well as daily lunches, a parking stipend, and all books and materials are funded by a grant from the Minnesota Department of Education Math-Science Partnership. Univ. of MN, Twin Cities, East Bank Campus. For more information regarding academic requirements, please contact ITCEP at 612-625-2861 or itcep@umn.edu or visit http://www.itcep.umn.edu/teachers/profdev/

TI-NSpire at Lakeville South High School

Lakeville South High School will be hosting a stop on the **TI-Nspiration Tour** on **Friday, June 20.** TI's newest learning tool creates a dynamic dimension for students to visualize concepts and take an interactive role in their learning. Come see how exploring multiple representations of a problem on a single screen can help students develop a deeper understanding of concepts. Experience how the use of electronic N-Spire documents further aligns with teaching practices proven to enhance learning!

Friday, June 20 9:00-4:00 — Lakeville South High School, Lakeville MN
Registration: $25 per person (includes lunch)
Register at http://TI-Nspire.com/nspirationtour

Participants receive a $100 discount coupon to attend a T^3 TI-Nspire workshop, certificate of completion, and 30-day trial of TI-Nspire computer software.

Contact Jason Molesky (jmmolesky@isd194.k12.mn.us) if you have any questions.

For Mathematics Teacher Educators

Join the Pioneers: 2-day workshop for mathematics educators interested in using electronic simulations to teach current and future teachers. **June 30—July 1, 2008** in Minneapolis.
For details, see www.edmath.org/MATtours/simulations/workshops/register.php or query Larry Copes: copes@edmath.org, 651/451-3720.

Standards-Based Workshop for High School Teachers—Macalester College

The Intersection of Algebra and Geometry July 7—18, 2008

Focus: The use of coordinate axes in the study of geometry was a radical break with the Greek traditions, but it has proved to be a wonderful analytical tool. There was a time in our country when Analytic Geometry was a stand-alone course in the curriculum, and though many of the ideas are thoroughly incorporated in calculus courses, a lot more has fallen by the wayside. Much of this neglected material provides a rich context for geometry, a context we plan to exploit in this institute. A heavy emphasis will be placed on incorporating group work, both in the workshop and in the classroom, developing problems to augment the middle and high school geometry curriculum, looking at student work, and using dynamic geometry software

Faculty: **Wayne Roberts**, Professor of Mathematics, Macalester College; chair of the Calculus Reform committee of the Mathematical Association of American (MAA); directed the NSF-funded project producing Resources for Calculus, published by the MAA; founded the MN State High School Mathematics League. **Terry Wyberg**, former high school mathematics teacher in the Minneapolis Public Schools, currently Lecturer in Mathematics Education at the University of Minnesota; currently working on a NSF-funded curriculum writing project and also the President-Elect of the Minnesota Council of Teachers of Mathematics.

Funding: Participants will receive a $100.00 per week stipend in addition to having costs of materials, including daily lunches. These professional development efforts are being supported by the federal 2007-08 Improving Teacher Quality Program and Macalester College.

Attention Non-metro Area Teachers: Our grant will provide free room and board for five teachers who live too far outside of the metro area to commute. Weekday housing will be in an air-conditioned room in the Macalester Residence Hall. Please check the appropriate box on the application from if you are applying for one of these residential positions.

Schedule: This professional development opportunity demands an ongoing commitment from participants. The summer workshop will run from 8:30am to 3:30pm for ten days from July 7th to July 18th. Four (4) dinner meetings from 4:30pm to 7:30pm will be held during the academic year.

Macalester College will provide 2 graduate credits for those who choose to undertake a project in conjunction with the workshop.

Registration: Registration is limited to 30 participants. Priority will be given to middle and high school mathematics staff from St. Paul and Minneapolis public schools, charter schools, or alternative schools. Registrants who have been accepted will be notified immediately.

For registration and additional information contact any of the following:
Dr. Wayne Roberts, (651) 765-2871, wayneinroseville@msn.com
Marty Gaslin, (651) 730-4603, marty.gaslin@spps.org
Lynn Garrett, (612) 668-5338, lynn.garrett@mpls.k12.mn.us

BestPrep's Technology Integration Workshop helps teachers enliven their lessons by integrating technology and workplace skills. Participants bring a previously taught lesson plan that they would like to improve by developing a new approach for teaching the content. With the help of a Technology Integration Specialist, teachers develop at least one technology infused lesson or unit to use in their classroom during the next school year. The collection of all previously developed lessons can be found online at http://www.bestprep.org/TC/tctcell.html.

BestPrep Technology Integration at Wayzata High School

As part of the program, teachers are connected with a volunteer Business Partner. They spend a half-day job shadowing their Partner to better understand the skills students need after graduation. Teachers use this experience to develop more relevant curriculum that connects with real-world applications.

The Workshop is offered at Wayzata High School from **July 28-31, 2008**. Teams of teachers are invited to attend. Teams consist of 2 or more teachers from the same school or district. The fee for teams to participate is $175 per person for two team members; 3 or more members is $150 each; and the individual fee is $200 per participant. (The Workshop fee qualifies for Perkins and Tech Prep funding.)

More information and applications are available online at http://www.bestprep.org/TC/tcworkshop.htm or by calling Bonnie Vagasky at the BestPrep office 763-398-0090 x227.

"My job shadow was an excellent match for my educational need in bringing technology into the course. I saw the knowledge and skills needed in the field, and first hand experience in the court room."

~Cindy Drahos, Burnsville High School, 2007 Integration Workshop Participant

"I am very excited to go back to school and share the things I learned with my principal and the other leaders in my school."

~ Shirley Poelstra, Edison High School, 2007 Integration Workshop Participant

Professional Opportunities and Programs for Students

International Teacher Program

The Toyota International Teacher Programs are fully-funded, short-term international professional development opportunities for teachers. Educators of different disciplines, grades and backgrounds are selected to travel together, study program themes, and bring these experiences home to their classrooms. Comments from past participants highlight the educational benefits:

> "International opportunities such as these completely expand our worldviews and shift our priorities. My approach to teaching has changed - I have become more passionate about making my students global citizens with knowledge of and sensitivity to international issues."

Toyota Motor Sales, U.S.A., Inc. sponsors this program to honor secondary school teacher's commitment to education. In 2008, study visits to the Galapagos will be open to librarians and classroom teachers (grades 6-12, all subjects) from all fifty states and the District of Columbia.

Galapagos Program: The Galapagos Program is a 12-day study program from **November 22 – December 6, 2008** geared toward international and environmental study. Participants work together to create an interdisciplinary environmental lesson that is shared with teachers on the Galapagos Islands. Applications for the 2008 program are available and due no later than May 9, 2008.

Spread the word to eligible teachers and librarians in your area. If you have any questions or would like more information, visit the website at www.iie.org/toyota or contact Kaitlyn Jones by email at toyotateach@iie.org or by phone at (toll-free) 877-832-2457.

MN Institute for Talented Youth at Macalester College

MITY (Minnesota Institute for Talented Youth), Macalester College, 1600 Grand Avenue, St. Paul

Expand Your Mind: Classes for current 7th – 12th graders
Session A: **June 16 – June 27** 8:30 am – 4:00 pm
Session B: **July 7 – July 18** 8:30 am – 4:00 pm
Tuition: $495 – Commuter; $1,270 – Residential (*Some financial aid available)*

ExplorSchool: Classes for current 4th – 6th graders
Session: **June 16 – June 27** 8:30 am – 4:00 pm
Tuition: $485 (*Some financial aid available)*

For program catalogs & applications: www.mity.org or 651-696-6590

GEMS: Girls Experiencing Mathematics in the Summer
June 22-June 27, 2008

The seventh annual GEMS (Girls Experiencing Mathematics in the Summer) Camp for mathematically talented high school girls will be held June 22 - June 27 at the **University of St. Thomas** (UST) in St. Paul. During the residential camp, sixteen girls participate in two mini-courses and attend a career panel and banquet where local professional women share how they use mathematics on the job. Participants also enjoy special presentations on mathematics such as the topology of the Four Canoes sculpture on campus and Actuarial Science. At the end of the week, they present their own explorations into mathematics at a family reception at the end of the week. Participants will also visit the Science Museum and enjoy fun recreational activities.

More Student Opportunities

The GEMS Camp has been supported by the UST Center for Applied Mathematics, the Tensor Grant Foundation through the Mathematical Association of America, the UST Department of Mathematics and the UST College of Arts and Sciences, and St. Paul Traveler's Insurance Company. The fee for 2008 is $510 and includes all fees except travel to and from UST. If you have students who are interested but have serious financial difficulties, please encourage them to apply and to include a letter describing their situation. We will assist such applicants in searching for funding.

Faculty involvement includes Brenda Kroschel, Melissa Loe, Jeff McLean, Lisa Rezac, Cheri Shakiban, and Heekyung Youn. Participant reactions from their camp evaluations:

> "Wow! What an awesome experience! The camp was fantastic and I will recommend this camp to any girl with a strong interest in math."
>
> "This camp was a great way to spend a week, learn some math, have a taste of college life, and make new friends."
>
> "I loved meeting all of the people who decided to come to this camp. It was great to see young women as interested in math as I am."

For more information about the GEMS Camp and application forms, please visit http://www.stthomas.edu/gemscamp or contact Lisa Rezac at lmrezac@stthomas.edu

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Mathematics Awareness Month

April 2008

Theme:
Math and Voting

www.mathaware.org

The American Mathematical Society, the American Statistical Association, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics announce that the theme for Mathematics Awareness Month 2008 is ***Math and Voting***.

In a presidential election year, the term "voting" brings to mind national elections. Candidates are vying for attention in debates and primaries, polls are taking the pulse of the electorate, blogs are offering opinions on everything candidates say, and, ultimately, a general election leads to the selection of the next President of the United States. Many citizens are deeply engaged in these processes; others pay varying degrees of attention. Regardless of their involvement, however, most people wonder at some point: "Does my vote matter? Is the election process fair? Are the votes being counted correctly?" The answers to these questions are incredibly complex, but, fortunately, **mathematics and statistics provide the means to deal with the complexity** of how votes are cast and counted and how that influences the outcome. For example, statistics provides ways to identify, measure, and address sources of error, and mathematics provides insights into the effect of different voting systems on the outcome of an election.

Voting is not just about electoral politics, however; it's part of everyday life. "Voting" is something that happens in many contexts not related to politics. In any situation in which preferences are expressed—where to have dinner, how to raise money for a charity, who makes the team, etc.—voting in some way occurs. Surprisingly, different voting systems often yield different outcomes.

Resources for this year's Mathematics Awareness Month are designed to help explain what makes these votes matter, as well as how the voting system used affects the outcome, regardless of the context of the voting. At www.mathaware.org, you can view and/or download these articles and essays, as well as a copy of the 2008 poster, "What Makes My Vote Matter?"

Misconceptions about Measurement: Helping Your Students Measure Up

Feature Article

Contributed by

Jason Schorn &
Dr. Rhonda Bonnstetter

Southwest Minnesota State University, Marshall, MN

Measurement is one of the most fundamental aspects of our daily lives; we use thermometers to measure the fever of children, we use stopwatches to measure the quickness of athletes, we interpret our speedometer to maintain appropriate speed, and we use the Richter scale to measure the intensity of an earthquake; but do our students really understand the concepts of measurement?

Measurement is the most fundamental to all of mathematics because the concepts of measurement are connected to the other mathematical strands: Geometry, Statistics, Data Analysis, and Algebra. Measurement is also connected to other subjects such as science, social studies, and art. Measurement is involved in our daily lives, all of mathematics, and every other academic discipline. The *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics, 2000) states that "instructional programs from prekindergarten through grade 12 should enable all students to -

1. Understand measurable attributes of objects and the units, systems, and process of measurement; and
2. Apply appropriate techniques, tools, and formulas to determine measurements (p. 44).

In the Third International Mathematics and Science Study (TIMSS), American fourth grade students scored higher than the international average in all math categories except one: Measurement (Taylor, P., Simms, K., Kim, O., & Reys, R., 2001). What does this mean for our students? Where do our students have misconceptions about measurement, and what might be causing these problems? In *Teaching for K-12 Mathematical Understanding Using the Conceptual Change Model* (Stephans, J. I., Schmidt, D. L., Welsh, K. M., Reins, K. J., & Saigo, B. W., 2005), the authors suggest that students:

- Have difficulty estimating length, distance, mass, volume, and temperature, often due to lack of experience in comparing and relating standard and nonstandard units of measure;
- Often communicate the attributes of numbers merely as numbers, without identifying the appropriate units in a label;
- Lack understanding of concepts related to area and volume and the derivation of the formulas to calculate them;
- Confuse the relationships between units such as cm^2 and cm^3 by using the same ratio on area and volume that they used for linear units;
- Confuse related measurements, especially weight and mass, speed and velocity, heat and temperature, force and energy;
- Have confusion regarding the tools to use to measure certain attributes;
- Frequently fail to select and report appropriate levels of precision.

These difficulties result in part from a variety of factors, including: prior instruction that focused on solving problems by using formulas and algorithms before students understood the underlying concepts; learning measurement skills from textbook activities rather than from authentic measurement situations and experiences; little or no attention to analyzing what makes an attribute measureable; and asking students to convert measurements rather than to develop an understanding of multiple systems. Without providing hands-on experiences, students are being deprived of real-world problems involving measurement. Students will not understand measurement until they explore the possibilities themselves (Martinie, 2004).

So how can we help our students to overcome these problems? The test scores from TIMSS have identified some of our weakness as unit conversions and estimations (Thompson, T.D. & Preston, R. V., 2004). Before students can get familiar with each measuring system, they need to become accustomed to common benchmarks. Benchmarks are references to the attributes of objects such as the length of a paperclip as being about one inch and the weight of a paperclip as being about one gram. Students can compare the length of their forearm as being about one foot and length of the space between their knuckles as being about an inch. The critical concept of benchmarks is to make students acquainted with the size of specific measurements which are familiar to them by using the benchmarks as references. Don't compare the length of football field to something if students have not seen a football field. Students need benchmarks which are significant to their personal lives. Benchmarks must be identified in both measuring systems for American students (Joram, E., Gabriele, A., Bertheau, M., Gelman, R., & Subrahmanyam, K., 2005). Once benchmarks have been established for students, teachers can introduce estimation with standard units. Test scores have shown American students are giving inconsistent estimates because of inadequate benchmarks. Some people think students will "outgrow" this phenomenon and learn how to estimate with everyday living experiences. This is how-

ever not the case. Studies have shown college students have the same problems as the students in primary school (Thompson, T. D. & Preston, R. V., 2004).

A study by Elana Joram, Anthony Gabriele, Myrna Bertheau, Rochel Gelman, and Kaveri Subrahmanyam (2005) showed significant improvement in estimation by using the Reference Point Strategy (RPS). The RPS is also known as the benchmark strategy. The study showed four improvements for students who used the RPS on estimation questions about measurement:

1. The use of RPS was statistically associated with greater estimation accuracy.
2. Students who estimated using the RPS had more accurate representations of standard linear units.
3. Students who used the RPS have enhanced representations of linear units which lead to more accurate estimates.
4. When standard units are represented by reference points, they seem to be more easily recalled and imagined than their corresponding standard units.

Once benchmarks are identified, students need to compare benchmarks between the two different measuring systems. Students need to know a meter is longer than a yard, a liter is bigger than a quart, and 32º Celsius is warmer than 32º Fahrenheit, for example. Once again, students need personal experiences when comparing the differences between two measuring systems. Math and science teachers could work simultaneously and make interdisciplinary lessons for comparing benchmarks.

Another disadvantage for American students versus students from other countries is that we need to learn both the customary (English) and metric system. If the United States is going to be a leader in the global economy, students will need to become familiar with both measuring systems. Students will need the ability to make conversions within each system as well as conversions between the two systems. From the results of TIMSS, American students struggled with questions about the metric system. An article by Mark Taylor, Ken Simms, Ok-Kyeong Kim, and Robert Reys (2001) revealed many difficulties faced by American students, who:

1. Lack the opportunity to experience the metric system in and out of school;
2. Don't develop a conceptual understanding of the basic units of the metric system;
3. Learn from mathematics curriculum that briefly mentions the metric system but does not emphasize it;
4. Only use metric system for length in school; and
5. Don't recognize that the metric system is intended for everyday use.

It's apparent American students lack experience with the metric system. The only frequent experience they are likely to have is buying a one- or two-liter bottle of pop. To demonstrate the second disadvantage of the article, ask an American student to explain, "Which is bigger, a gallon or two two-liters?" This will demonstrate the lack of understanding of the basic units of the metric system. The article criticizes the curriculum as saying "the metric system is treated as and introductory topic at best".

To help American students become more familiar with the metric system the authors give some suggestions: assess what your students know about the metric system, check the students' level of sensitivity of the use of the metric system in everyday life, and assess the students' curriculum and instruction (Taylor, P., Simms, K., Kim, O., & Reys, R., 2001). These strategies are obvious but shouldn't be omitted by American teachers. Teachers need to determine the student's prior knowledge, show the relevance, and develop a curriculum which includes hands-on experiences that incorporate the metric system. American students can learn the concepts of the metric system if time is sufficient enough. The metric system could be taught with along with scientific notation. This is just one method to incorporate the metric system into today's curriculum (Joram, E., Gabrielle, A., Bertheau, M., Gelman, R., & Subrahmanyam, K., 2005).

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Foundations for Success, the final report of the National Mathematics Advisory Panel, was released last week at the final meeting of the panel at a middle school in suburban Washington, D.C. The panel, which was formed in 2006 by executive order of President Bush, was charged to examine and summarize the scientific evidence related to the teaching and learning of mathematics, with a specific focus on preparation for and success in learning algebra. The full report may be accessed at www.ed.gov/mathpanel

Look for commentary, talking points, and perspectives in a future issue of *Mathbits.*

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Please submit items for publication in the Summer issue of *Mathbits* to tlgonske@nwc.edu by May 9, 2008. Email or call 651-631-5228 with any questions. - Teresa Gonske, Editor