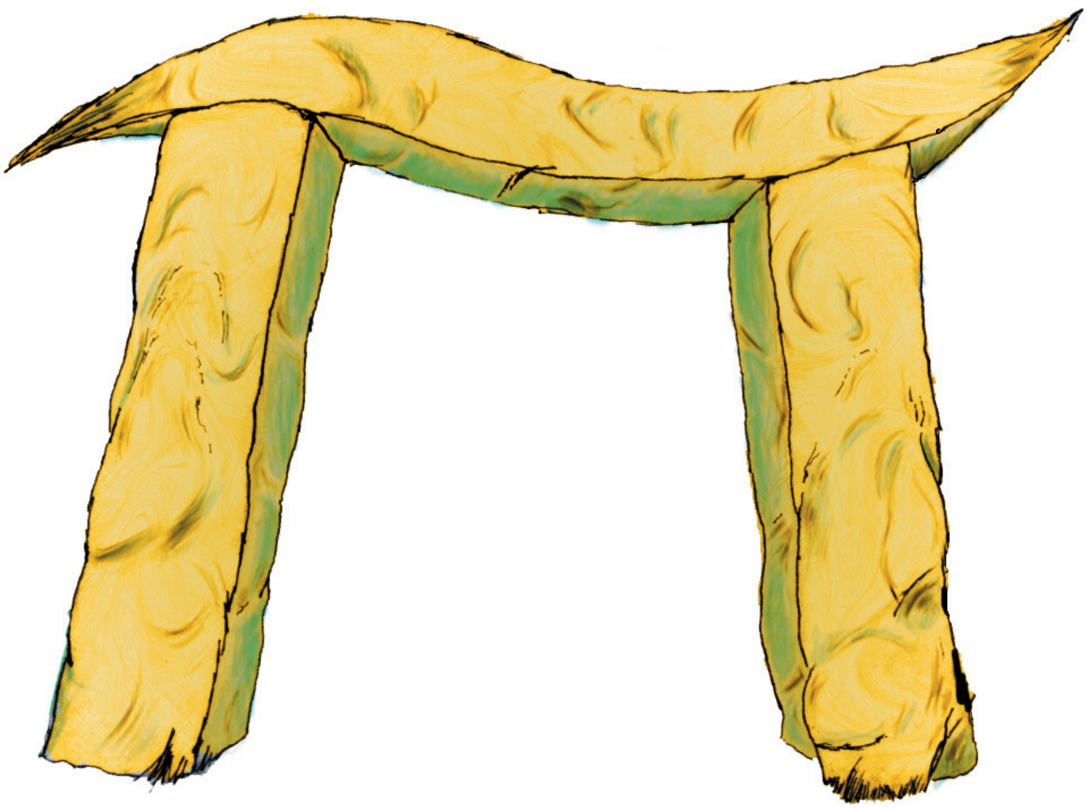
Texas Mathematics Teacher

Volume LI Issue 2 Fall 2004

See Details on CAMT '05
on page 19



prepare for
Pi Day
page 6

Check the Back Cover
for your membership card
and renewal date

http://www.tenet.edu/tctm/

Texas Council of Teachers of Mathematics
2004 Mission and Goals Statement

MISSION

To promote mathematics education in Texas.

GOALS

Administration

- Investigate online membership registration through CAMT and/or the TCTM website

Publications

- Survey membership to identify what they want in the Texas Mathematics Teacher (TMT)
- Review and redesign the TMT journal and the TCTM website based on above findings

Service

- Increase the number of Mathematics Specialist College Scholarships
- Increase the donations toward Mathematics Specialist College Scholarships
- Staff CAMT registration with volunteers and other volunteers as needed
- Advertise affiliated group conferences on the TCTM website and in the TMT

Communication

- Maintain an e-mail list of members for timely announcements
- Communicate with affiliated groups in a timely manner
- Improve communication with NCTM consignment services

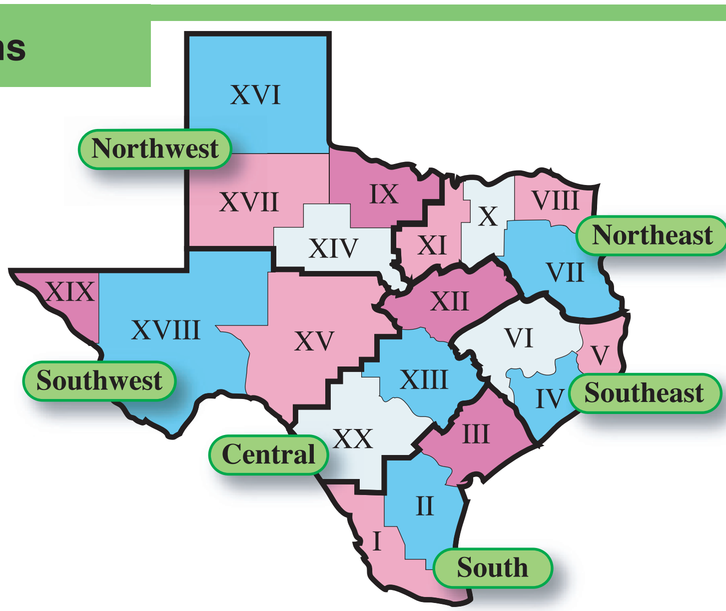
Membership

- Based on information gathered by TCTM board members as to advisability, advocate at CAMT Board meetings for TCTM membership to be required for all CAMT participants
- Encourage affiliated groups to include TCTM registration on their membership forms

Public Relations

- Staff and sponsor the NCTM/TCTM booth at CAMT
- Follow NCTM *Communication Guidelines* (1993) for increased media coverage of TCTM membership and issues relevant to our mission

TCTM Regions



TCTM Past-Presidents

1970-1972	James E. Carson	1982-1984	Betty Travis	1994-1996	Diane McGowan
1972-1974	Shirley Ray	1984-1986	Ralph Cain	1996-1998	Basia Hall
1974-1976	W. A. Ashworth, Jr.	1986-1988	Maggie Dement	1998-2000	Pam Alexander
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1978-1980	Anita Priest	1990-1992	Karen Hall		
1980-1982	Patsy Johnson	1992-1994	Susan Thomas		

Texas Mathematics Teacher

A PUBLICATION OF THE TEXAS COUNCIL OF TEACHERS OF MATHEMATICS

Volume LI Issue 2 **Fall 2004**

Articles

Features

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Texas Mathematics Teacher, the official journal of the Texas Council of Teachers of Mathematics, is published in the fall and spring. Editorial correspondence should be mailed or e-mailed to the editor.

Call For Articles

The ***Texas Mathematics Teacher*** seeks articles on issues of interest to mathematics educators, especially K-12 classroom teachers in Texas. All readers are encouraged to contribute articles and opinions for any section of the journal.

Manuscripts, including tables and figures, should be typed in Microsoft Word and submitted electronically as an e-mail attachment to the editor with a copy to the director. No author identification should appear on or in the manuscript. A cover letter containing author's name, address, affiliations, phone, e-mail address, and the article's intended audience should be included. After refereeing, authors will be notified of a publication decision.

Teachers are encouraged to submit articles for ***Voices From the Classroom,*** including inspirational stories, exemplary lessons, or management tools. If submitting a lesson, it should include identification of the appropriate grade level and any prerequisites.

Items for ***Lone Star News*** include, but are not limited to, NCTM affiliated group announcements, advertisements of upcoming professional meetings, and member updates.

Businesses interested in placing an **advertisement** for mathematics materials should contact Mary Alice Hatchett.

Deadline for submissions: Fall, July 1 Spring, January 1

Letter from the President

Dear TCTM Members,

It's late in the fall semester and I wish we had delivered the journal to you sooner. Each year I think I this will be the year that I have a handle on my priorities both personal and professional. However, the pace of my life continues to accelerate and my commitments grow. Even so, while it's been a few years since I was in the classroom, I know that the responsibilities I assumed as a teacher were some of the largest burdens I ever carried. Planning for teaching and assessing, implementing my plans (yikes, isn't that hard to do sometimes!), trying to figure out how to do everything better, being available to my students both emotionally and academically, spending time on bureaucratic details like attendance, dealing with colleagues and supervisors (some I liked and some I didn't), eating right (this rarely happened), and exercising (a luxury that only happened when I worked part-time) used up every minute. And then there was family.

So, why waste your time with this nostalgic trip into my past? My years of experience have led me to acknowledge that no matter how crushing my workload, or how fast my life speeds up, what I do about it is entirely contingent on what I believe CAN be done about it. When belief systems are changed, the subsequent effects are phenomenal. So how do we affect beliefs?

Have you ever tried something once and it didn't work out? Personally, I can think of several recipes I will never try again. Professionally, there were some classroom management strategies that weren't too successful either. Teachers are willing to investigate and share successful teaching strategies. We are willing to study the TEKS, to identify or create great lessons, to design better assessments and to look at student work. But in the long run, does every teacher believe that this work will make a difference? Are we willing to implement new strategies, new lessons, different types of assessments? If we do, how many chances do we give them? Usually one, or is it more? Unfortunately, because something doesn't work once for you doesn't mean it doesn't work. Can we identify why something new didn't work? Did it not work for us as teachers or for students as learners? What evidence do we trust?

What changes beliefs about what will work is the successful implementation of it. In teaching we get this feedback most frequently from student success stories. Identifying practices that are effective for EVERY child, not just for some of them, is our most challenging task. Don't settle for believing that it's good enough for SOME of the class to understand. Recognize that there are ways to reach every child, and give the strategies you've heard about more than one chance to work. Changing a fundamental belief system about what is possible is without a doubt one of the most difficult things one can do. Please believe that you can reach every student, and this belief will have a profound effect on your life and theirs.

In more general news, I am pleased to announce the CAMT board approval to offer TCTM membership within the CAMT registration fee. This may greatly increase the membership of our organization and provide us with a stronger voice in policy development with respect to mathematics education. Please look for additional details on this change in the spring journal and in the CAMT literature.

I wish you a happy and safe 2005.

Sincerely,

Cynthia L. Schneider
TCTM President 2002-2004 ■

NCTM 2005 Annual Meeting

Anaheim, California

April 6-9, 2005

Embracing Mathematical Diversity

Facilities; Anaheim Convention Center, Anaheim Marriott Hotel, Hilton Anaheim Hotel

Hosted by: California Mathematics Council-Southern Section and its local affiliates

http://www.nctm.org/

Texas keynote speakers include:
Cathy L. Seeley, President
National Council of Teachers of Mathematics
Reston, Virginia
Charles A. Dana Center,
University of Texas at Austin
Austin, Texas
Who's Doing the Talking

Carmen T. Whitman
Mathematics For All Consulting
Pflugerville, Texas
and
Emma Trevino
University of Texas at Austin
Pflugerville, Texas
Middle School Mathematics: Let's Give it the Attention it Needs

Affiliate Groups

These are local affiliated groups in Texas. If you are actively involved with them, please send future meeting and conference information to Cynthia Schneider at *<cschneider@mail.utexas.edu>* so we may publicize your events. Contact information for each group is available on the NCTM website,

http://www.nctm.org.

- Alamo District CTM
- Austin Area CTM
- Big Country CTM
- Central Texas CTM
- CTM at TAMU- Corpus Christi
- CTM at TAMU- Kingsville
- East Texas CTM
- Fort Bend CTM
- Greater Dallas CTM
- Greater El Paso CTM
- Houston CTM
- Rio Grande Valley CTM
- Texas South Plains CTM
- 1960 Area Mathematics Council

New online offering from MAA

The Mathematical Association of America announces the launching of a new online magazine and resource in the history of mathematics and its use in teaching, entitled *Convergence: Where Mathematics, History and Teaching Interact*, with the cooperation of the National Council of Teachers of Mathematics and the financial support of the National Science Foundation. The target audience is teachers of grades 9-14 mathematics, be they secondary teachers, two- or four-year college teachers, or college teachers preparing secondary teachers. The magazine will include articles dealing with the history of various topics in the curriculum, classroom suggestions designed for immediate use, historical problems, a "what happened today in history" feature giving mathematical events that happened on that date in history, interesting mathematical quotations changing daily, reviews of books and teaching materials, and a calendar of upcoming meetings and other events in the history of mathematics and its use in teaching. To visit the magazine, point your browser to

http://convergence.mathdl.org/

For more information, or to contribute, write to the editors: Victor J. Katz: *<vkatz@udc.edu>*; Frank J. Swetz: *<fjs2@psu.edu>*

3.14159265335

Slices of Pi:
Rounding Up Ideas for Celebrating Pi Day

Every March 14 (3-14) is Pi Day! This is a great vehicle (if an "irrational" reason) for classes to have fun as they experience some interesting mathematics, especially mathematics connected to the number π. Teachers who assume this commemoration is obscure may be shocked to see all the references and resources on the Internet (e.g., using Google to search for "Pi Day" or from the list on p.2 of the January/February 2004 *NCTM News Bulletin*).

Celebrations are held not only in classrooms but also in other institutions coast-to-coast, ranging from San Francisco's Exploratorium to New York's Goudreau Museum of Mathematics in Art and Science. This article shares ideas to help teachers plan their own celebrations (for their clubs or classes or for their whole school) for Monday, March 14, 2005. While non-mathematical activities such as eating pie are universal, the content of the mathematical explorations is mostly for students at the secondary level except where noted.

Pi Day Entertainment

The most popular time for a Pi Day party is 1:59pm (3.14159...), a good time for some kind of afternoon snack. The obvious choice for refreshments is, of course, several kinds of pie (perhaps decorated with the letter pi or some digits of pi, or with the diameter and circumference outlined with some topping or icing), perhaps accompanied by a pie-making or pie-eating contest. Or a contest to carve the most mathematical pumpkin ("pumpkin pi"). One could assemble a veritable pi picnic of munchies that begin with the letters "pi": pizza pie, pineapple(be sure to note the Fibonacci numbers in the spirals before it's cut), pickles, pistachios, pinto beans, pimento, pita, pilaf.

The event can also include mathematical entertainment related to the number π, such as music (perhaps played on a pi-ano). One high school math club composed a song by assigning the first 50 digits in π to the key of C, letting 1 = middle C, 2 = the D above middle C, etc. (Lewellen 1987). Other melodies based on pi's digits can be found on the Internet. Also, Lesser (2000, 2003) offers an informative and playful lyric "American Pi" whose chorus contains a mnemonic for the first 6 significant figures:

> "Find, find the value of pi —-
> starts 3 point 1 4 1 5 9
> Good ol' boys gave it a try, but the decimal
> never dies, the decimal never dies..."

The lyric's three verses span historical highlights including a Biblical value and the Indiana legislature's 1897 consideration of a bill that declared π equal to 4 (Hallerberg 1977)! Students may sing the lyric to the tune of Don McLean's #1 1971 hit "American Pie" (though students may be more familiar with its return to the charts in 2000 thanks to Madonna). Teachers wanting to help students distinguish between the area and circumference formulas for a circle (apparently telling them to consider which one will have squared units isn't sufficient or most effective for some students) might offer this additional short song:

Circle Song (lyrics by Lawrence Mark Lesser; may be sung to the tune of "Twinkle, Twinkle Little Star")

> Take your finger round a jar
> Circumf'rence equals 2πr.
> For area, you multiply
> R squared by that number π.
> Twinkle, twinkle, you're a star
> Knowing math will take you far!

Bill Amend's nationally syndicated comic strip "FoxTrot" has actually had several (e.g., 11/25/00, 10/26/01, 1/13/04) strips whose punchlines are based on pi's having an infinite number of digits. Other jokes about π are related to specific circle formulas, such as these three (try making up your own!):

> "Do you know pi r squared, Grandpa?"
> "Nonsense! Pie are round, and cornbread are square!"

> "In the Greek alphabet, π is the sixteenth letter (and 16 is the square of 4). In the English alphabet,

p is also the sixteenth letter, and i is the ninth letter (the square of 3). Add them up (16+9), and you get 25 (the square of five). It's no wonder that they say: Pi are squared!"

"What do you get when you divide the moon's circumference by its diameter?"
"Pi in the sky!"
(alternative answer: "MoonPie")

Pi-related activities abound, in varying degrees of playfulness. The wall clock in a trigonometry classroom could be decorated to tell time in radians. A blindfolded cologne contest could be held to see if someone can recognize the woodsy fragrance called Pi (released in 1999 by Givenchy) or see if people rate it higher than other colognes. Also, students can take turns trying to break open a candy-filled π-shaped piñata. Or play ping-pong with homemade π-shaped paddles. Or do exercises with a Pi-lates ball. Or make the best pi sculpture out of sand or ice. Or make the best pi jewelry (I have seen π earrings and a π necklace) or painting a digit of pi on each fingernail. Maybe a session of "transcendental meditation" about the transcendental number pi. A poetry contest or reading could be held, including mathematical poems in Growney (2001) such as Wislawa Szymborska's "Pi". By the way, if a student happens to suggest showing the 1998 indie movie *Pi* (which won Darren Aronofsky the Director's Award at the Sundance Film Festival), teachers and math club sponsors should be advised *not* to show the movie (at least not without prior administrative and parent permission), as it is rated R for language and disturbing images.

Pi Day Contests

Perhaps a contest of who can recite the most digits of π (or come up with the best mnemonic for remembering them) or a trivia contest about pi (e.g., Eve Andersson's

http://eveander.com/trivia/

or facts from Beckman (1971), Schepler (1950), or Berggren, Borwein, & Borwein (2000), or Posamentier & Lehmann (2004)). Mnemonics are usually sentences where the number of letters in the nth word corresponds to the nth digit of pi (thought question: what happens at the 33rd digit?). Digit contests (or huge posters of the first several thousand digits) should be kept in perspective with the knowledge that knowing pi to as few as 50 digits more than suffices to estimate the circumference of a circle the size of the known universe to the accuracy of the size of a proton! As physics instructor Spenner (2003) explains: "The radius of a typical nuclear-bound proton is 10^{-15} meters. The universe has been expanding for about 15 billion years, so its edges are roughly 15 billion light years across, which works out to about 10^{26} meters, which is 10^{41} times the size of a proton." (Speaking of physics, March 14 is not only Pi Day, but also the birthday of Albert Einstein!)

Inspired by Waldner (1994), I launched a series of Pi Day events for Emery High School this year. One of the events featured "problems of the day" posted in the hallways for all to try. It is especially nice if such problems relate to circles or spheres, such as:

Which deal is better: an 8" $3.50 pizza or a 14" $10 pizza?

Imagine a wire snugly wrapped around the earth's surface at the equator. If the wire were made 100 feet longer to form a circle at a uniform height above the earth's surface all the way around, how high off the ground would the wire be?

Another event for the school was a contest in which each student could choose one of these three categories to enter:

- Essay: Double-spaced typed essay (<500 words) on the topic "Mathematics is Everywhere".
- Art: Art with a mathematical theme or constructed by mathematical principles (e.g., symmetry, perspective) or explicit formulas. This could include a variety of products such as "fractal art", tesselation art, etc. The final product might be two-dimensional (a poster or painting) or even a 3-D model/sculpture.
- Creative Writing: Lots of options (poem, lyric, etc.) as long as product has originality and mathematical theme or mathematical principle used in construction.

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Some schools or math clubs have the tradition of scheduling local or regional interschool competitions sometime near Pi Day.

Pi Day Mathematical Explorations

Most teachers are familiar with an activity to estimate π empirically by having students measure (with a tape measure) the circumference and diameter of circular objects (e.g., jar lids) of various sizes, discovering that the ratio *C/D* is about the same for all of them (e.g., Barnard and Wheeler 2003). This could be done even by upper elementary or middle school students, while high school students could go on to plot the values of *C* versus *D* and use technology to find the line of best fit (ideally without intercept). The slope of this line of fit would then be an estimate of π (e.g., Pyzdrowski and Holtan 1996).

Students can recreate or explore some of the more historically famous activities involving π, such as Archimedes' classical method for estimating π. For example, consider a unit circle with inscribed and circumscribed hexagons. A geometry student can verify that those hexagons have perimeters of 6 and $4\sqrt{3}$, respectively. Bounding 2π between these numbers results in estimating pi as between 3.00 and 3.47. The approximation improves as the number of sides in the polygon is increased (e.g., repeatedly doubled).

A geometric probability or Monte Carlo method of estimating π can be implemented as follows. A unit circle can be inscribed in a square in which *x* and *y* each range from -1 to 1. Since the ratio of their areas is $\pi/4$, we can set $\pi/4$ equal to the proportion of randomly generated ordered pairs within the square that land within the circle. Solving this proportion will allow us to estimate π. On the TI-83, one way of generating each ordered pair (x,y) of values within the square is to use the sequence -1 + 2* MATH ⇒ PRB ⇒ rand ⇒ ENTER ⇒ ENTER. [Note: rand is a number randomly picked from the interval (0,1).] Every ordered pair (x, y) such that $x^2 + y^2$ is less than 1 falls inside the circle.

http://www.mste.uiuc.edu/activity/estpi/

Another probabilistic method is Buffon's 1777 experiment using needles dropped onto a floor ruled with parallel lines uniformly spaced A units apart (the probability that needles of length L land on top of one of these lines is $\frac{2L}{\pi A}$). (Note that we choose L < A so that a needle can't hit more than one line.) To illustrate, suppose 100 three-inch needles are dropped on lines 12" apart, so L = 3 and A = 12. Suppose 16 of those 100 needles land so that they intersect a line. Setting that empirical probability of .16 equal to the theoretical probability $\frac{2L}{\pi A}$ yields an estimate of 3.125 for π. In a secondary methods course I teach for preservice secondary teachers, we went out in the hallway, used only the horizontal lines of the square floor tiles, and obtained a reasonably accurate estimate of π by having several student groups repeatedly drop 10 popsicle sticks! The expression $\frac{2L}{\pi A}$ can be derived with first-year calculus and appears in several books (e.g., Eves 1990).

In addition to activities that estimate pi, students can also do explorations of famous formulas that involve pi. For example, students can dissect a circle into 16 congruent sectors, and arrange them in alternating side-by-side orientations (picture two interlaced rows of pointy teeth) to form an approximate parallelogram with area $\left(\frac{C}{2}\right)\left(\frac{d}{2}\right) = \left(\frac{2\pi r}{2}\right)r = \pi r^2$ (e.g., Barnard and Wheeler 2003). A video showing this in an animation sequence is *Story of Pi* by Project MATHEMATICS. You can order it or see excerpts at

http://www.projectmathematics.com/storypi.htm

Now we have a way to make sense out of the formula without having to bring out the tools of calculus to evaluate this integral:

$$2\int_{-r}^{r} \sqrt{r^2 + x^2}\,dx$$

This video also has an animation sequence of Archimedes' method mentioned earlier.

Another activity allows students to predict and then measure how many "head-circumferences" (as measured by a tape measure horizontally around the head) tall they are. The typical result is 3, but students' predictions tend to be too high because they underestimate circumferences.

Ancient Connection: Biblical Pi

Students (pi-ous or not) are fascinated to learn that the value of pi is implied in the Bible (1 Kings 7:23): "He made the 'sea' [a copper tank for ritual immersion] of cast [metal] 10 cubits from its one lip to its [other] lip, circular all around, five cubits its height; a 30-cubit line could encircle it all around." After verifying that the passage most directly implies a value of 3, students can then discuss two interpretations, as have clergy and scholars (Tsaban and Garber 1998). Either 10 and 30 are approximations (students can discuss to what precision), or we must consider the tank's thickness (students can discuss how thick it would have to be) with 10 being measured outer lip to outer lip and the 30 measured around the inner surface. Also fascinating is a lesser-known gematria concerning the Hebrew word for "line" in the above passage. When that word is converted into the numerical equivalents of its written and spoken forms, respectively, the numbers 111 and 106 are obtained (Tsaban and Garber 1998). When 3 is multiplied by the ratio 111/106, the value obtained (3.14150943...) approximates π with accuracy greater than 99.997%!

Why the letter pi?

The first use of the Greek letter π to represent the ratio of a circle's circumference to its diameter seems to have been in the textbook *Synopsis Palmariorium Mathesios*, written by William Jones in 1706. He chose pi because it was the first letter of the Greek word 'perimetrog', meaning 'surrounding perimeter'.

- Usiskin, Z., Peressini, A. Marchisotto, E.A., and Stanley, D. (2003). Mathematics for high school teachers: An advanced perspective. Upper Saddle River, NJ: Prentice Hall.

Contemporary Literature Connection: *Life of Pi*

When I heard that Emery High School assigned the best-selling, award-winning book *Life of Pi* (Martel 2001) for all to read over the summer, I admit that the title made me think that it just might be a work (e.g., Blatner 1997) filled with mathematical beauty associated with the number pi or a book (e.g., Abbott 1976) that uses a mathematical framework as an allegorical vehicle to tell a sociopolitical story. While neither proved to be the case, this story of a zookeeper's son crossing the Pacific Ocean in a lifeboat with a Bengal tiger is enjoyable and interesting to read and did turn out to have occasional moments flavored by mathematics.

Having such a book assigned in your school's English classes may make for a more interdisciplinary Pi Day. Most of these questions can be answered just from the referenced excerpts so that this assignment does not exclude those who have not read the entire book, nor does it spoil the essence of the story for those about to read it. This list is designed to work either as a homework assignment or as a group activity that would take a full class period. Two Emery students, Brooke and Phillip, created impressive "Life of Pi posters" in which they brought these problems to life, artistically illustrated and adorned with a three-dimensional boat! Questions #1 and 6 specifically relate to pi or to circles, while the others address other aspects of mathematics.

Q1 Tired of being teased over his given name Piscine, the main character adopts Pi as his name. Discuss this passage from page 24: "In that Greek letter that looks like a shack with a corrugated tin roof, in that elusive, irrational number with which scientists try to understand the universe, I found refuge."

Q2 On pages 48-49, it says: "That which sustains the universe beyond thought and language and that which is at the core of us and struggles for expression, is the same thing. The finite within the infinite, the infinite within the finite." How might entities such as fractals relate to this?

Q3 Read pages 137-138 and make a reasonably accurate scale diagram of the lifeboat. Doing so is not only a good application of geometry, but also helps better visualize certain scenes and events of the story. (For something simply whimsical, try drawing Mr. Satish Kumar, who is described on page 25 as "geometric: he looked like two triangles, a small one and a larger one, balanced on two parallel lines.")

Q4 Read the information about the supply rations (starting on page 144) and create an original word problem involving them.

Q5 Discuss how Pi's "problem solving" on the boat compares to what "problem solving" in math.

Q6 On page 199, Pi asks: "If the horizon was two and a half miles away at an altitude of five feet, how far away was it when I was sitting against the mast of my raft, my eyes not even three feet above the water?" First, have students assess the accuracy of the statement in the first half of the question, assuming the earth to be a sphere of radius 3964 miles. Then, have students do a calculation to verify that standing up does not increase the visible horizon distance by as much as one might guess. [Hint: The only math required is the Pythagorean theorem, so the key step is to draw a diagram featuring a circle and a right triangle whose longer leg is the earth's radius, whose shorter leg (tangent segment) is the sight line and whose hypotenuse (secant segment) is the earth's radius plus the boy's height.]

Q7 Discuss this exchange from page 299:
"We find it very unlikely."
"So is winning the lottery, yet someone always wins."

When I discussed Q6 with Emery HS ninth grade geometry students, they were impressed with the practicality of being able to tell how far one can see when looking out to the horizon from a raft (or from a beach). We then opened up their (Holt, Rinehart, and Winston) textbook and found a problem with exactly the same idea applied to finding the effective signal range of a communications radio tower.

Coming Full Circle

There is richness and mystique surrounding the number pi -- the ratio that cannot be written as a fraction -- the number whose decimal has no end or pattern, yet is related to perfectly symmetrical circles and spheres. But Pi Day is about more than just the number pi and is for more than just so-called "math nerds" -- it is an affirmation that mathematics has not just utility, but also beauty, history, mystery, and joy.

Each teacher will have to select or adapt the ideas that work best in her classroom. For example, an elementary school teacher will not be able to use *Life of Pi*, but could instead use one of the books in the Sir Cumference series (e.g., Neuschwander 2002) or a book such as Ross (1992). Amidst some frivolity, we hope we have rounded up a variety of interesting and serious activities from which to choose. And may the heightened fun and inspiration of the day spill over into many mathematics lessons throughout the rest of the year. After all, math's not always a piece of cake, but sometimes it's as easy as pi.

■

Larry Lesser, Ph.D. • <Lesser@utep.edu>
Associate Professor • University of Texas at El Paso

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FEATURE

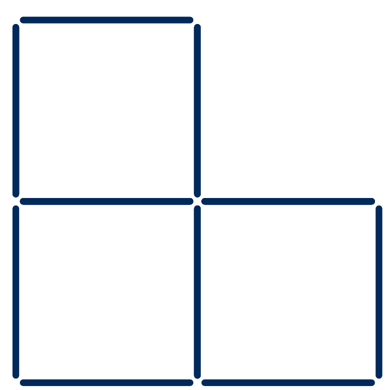
Puzzle Corner

Sticks #4 Puzzle

We are interested in how your students responded to this problem and how they explained or justified their reasoning. Please e-mail copies of your students' work, include your name, grade level, campus name and district name to Mary Alice Hatchett, Director of Publications *Texas Mathematics Teacher*. Selected submissions will be acknowledged and published in subsequent issues.

Please prepare a sketch of your solution

Arrange 10 craft sticks to form the following figure



Move two sticks to form four congruent rectangles.

TEA Talks

Hot News

For additional information, refer to the websites listed

- Accelerated Math Instruction (AMI) funds will be released earlier this school year than last year. The TEA should distribute funds to districts serving students in grades K-5 by October 1, 2004. The allocation is based on the number of students that failed to meet the passing standard on the 5th grade TAKS during the spring of 2004, the amount per student is $905. In order to receive the 75% funding allotment, districts must have completed all of the required reports from the 2003-2004 year. Funding should be utilized during the year to provide struggling mathematics students with interventions and programs that will assist them in learning TEKS content. Guidelines may be accessed at the following website.

  http://www.tea.state.tx.us/ayp/reading/ordering /2004-2005ARI_AMIGuide091404.pdf

- TEKS refinement for secondary is well underway and should soon be finalized by the State Board of Education. First reading for these documents will occur at the November meeting with final adoption during the January meeting. The same model used in the secondary TEKS refinement will be used to clarify the elementary TEKS. Suggested revisions should be emailed to Paula Moeller at the email address listed below. The refinement process will add additional clarity and precision to the already established Texas Essential Knowledge and Skills documents adopted in 1997.

  <Paula.Moeller@tea.state.tx.us>

- Student Success Initiative (SSI) grade advancement requirements for fifth grade students in mathematics and reading begin this year. New parent brochures that detail the requirements have now been posted on the TEA Student Assessment website. Hard copies will be mailed to districts for distribution to parents in early October. The Grade Placement Manual is in revision and will be posted on the TEA Student Assessment website later this fall. For more information on SSI grade advancement requirements visit:

  http://www.tea.state.tx.us/student.assessment/ resources/ssi/index.html

- The Texas Education Agency will not release tests every year due to a change in legislation created by HB 3459. This law requires fewer released tests; tests will now be released every other year. Since the Agency released all tests in spring 2004, another release will not occur until the spring of 2006. The legislature may decide to modify this law during the 79th legislative session that begins in January of 2005.

  http://www.tea.state.tx.us/student.assessment/ resources/release/

- The TMDS (Texas Mathematics Diagnostic System) expansion is set for this fall. TMDS is currently available for use with students in grades 5-8. Grade 3 TMDS diagnostics will be available in October. Algebra I, II and Geometry will also have diagnostics created and available by January 2005. This diagnostic assessment system is provided by legislative appropriation in HB1144. To use the system, districts will need to register and send data to Vantage Learning prior to accessing the system, even if the district was registered last year. Directions for registration and data file creation may be found on the TMDS website.

  http://www.accesstmds.com/tmds

- The textbook adoption cycle has been amended by the State Board of Education due to information presented by the TEA Textbook Division. Proclamation 2004 includes instructional materials for grades 6-12; AP/IB courses will also be included in this adoption. Proclamation 2005 will include Kindergarten systems, and grades 1-5 mathematics. Implementation using the new materials for secondary will begin in 2007 while elementary teachers will have new materials by 2008.

  http://www.tea.state.tx.us/textbooks/ adoptprocess/adoptioncycle.pdf

- Nomination forms for the Presidential Awards for Excellence in Mathematics and Science Teaching are now available. The award for this year will be available for math and science teachers in grades 6-12. Nomination forms must be submitted to Paula Moeller at the Agency prior to the application being sent to qualified candidates. Email Paula.Moeller@tea.state.tx.us with a completed nomination form for a deserving colleague. The nomination forms are available at:

http://www.paemst.org/2005_Nomination_Form.pdf

- Have you joined the TEA Mathematics Listserve? The latest information on statewide initiatives, policy, and assessment are available to members that have subscribed to this list. Join today and get the scoop on Texas mathematics.

http://www.tea.state.tx.us/list/

■

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Educational Consultant for Mathematics • Texas Education Agency

Paula Moeller • <Paula.Moeller@tea.state.tx.us>
Director of Mathematics • Texas Education Agency

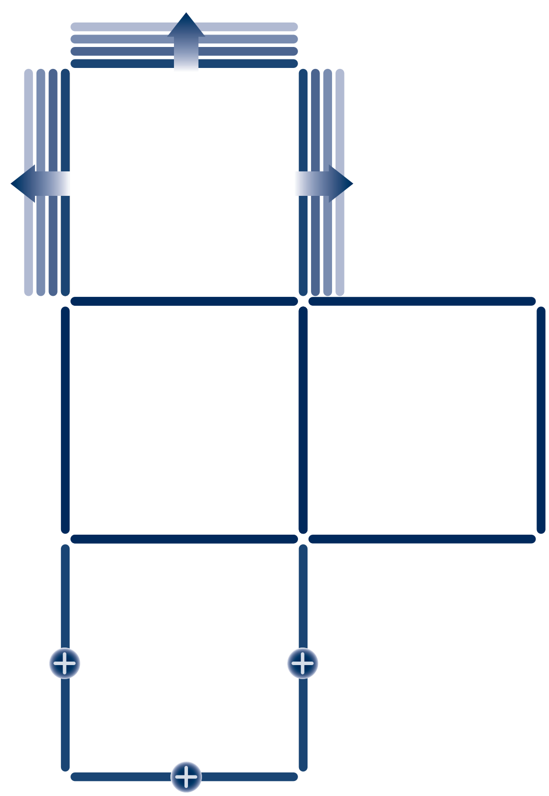
FEATURE

Puzzle Corner

Sticks #3 Answer

Arrange 10 craft sticks to form the origional figure. Move 3 sticks to form a verticle reflection of this figure.

Shown is a diagram of a solution



Why are Fractions so Difficult?

Teaching fractional concepts is a major topic of elementary mathematics. It is one of the most difficult and abstract concepts taught in elementary school. Perhaps one of the reasons for the difficulty and misunderstanding of fractional concepts is that **skills** rather than **concepts** are taught. The American Heritage Dictionary defines a concept as "something formed in the mind; a thought or notion" and a skill as "proficiency, facility, or dexterity that is acquired or developed through training or experience." (2000). In the traditional mathematics classroom, proficiency in rules and procedures for manipulating fractions are too often the main emphasis of fraction lessons.

Before teaching operations with fractions, students need a strong understanding of basic ideas or concepts of fractions. Most of the time spent teaching the "fraction chapter or unit" relates to the many algorithms that enable students to manipulate fractions. In the middle grades, it is common to accelerate instruction and teach rules and procedures for manipulating and operating with fractions because of the pressure and time demands of teaching the curriculum. However, rules and step-by-step procedures do not help students understand the concepts. Students lose interest in mathematics if they simply mimic and memorize rules and procedures. The state mandated curriculum, Texas Essential Knowledge and Skills (TEKS), require that a basic foundation in number, operation and quantitative reasoning be taught. Fractional concepts are a knowledge and skill that should be taught beginning in Kindergarten with understanding parts of a whole. In other grades, the TEKS emphasize comparing and ordering fractions, equivalent fractions, and operations with fractions. Therefore, just teaching algorithms for operations is a minor part of the curriculum.

Students must make sense of learning by investigating, reflecting and communicating. Understanding includes seeing how an idea relates or connects to other known ideas. To develop mathematical understanding, students must examine and invent methods, look at ways things work, see how things are alike/different and relate in different situations. It is then they will likely build new relationships and construct their own insights into the structure of mathematics. Just listening to a clear explanation and/or watching the teacher demonstrate a skill will not develop an understanding of a concept.

Some evidence of the difficulties students have in learning and understanding fractional concepts can be found at the adult or college level. At Texas A&M-Commerce, Mathematics for Elementary Teachers classes are filled with potential elementary and middle school teachers. One requirement of the class is that students show mastery of basic arithmetic. Each student is required to make a 90% (i.e. getting 18 out of the 20 questions correct) to demonstrate mastery of elementary mathematics skills. Students are given multiple opportunities during the semester to pass this requirement. In the first few days of the course, a sample exam is given to students to study so they know the basic requirements of the test. Figure 1 is a sample of the required competency exam.

All students have passed College Algebra as a prerequisite to Mathematics for Elementary Teachers. Typically, only 20% to 30% of the students pass the competency exam of basic arithmetic on the first try. It is also common for many students to take an hour (or more) to attempt this exam. Some students never pass the exam and do not pass the course. It is troubling that potential teachers are coming into the program without basic mastery of arithmetic. By far, the most trouble the students have is with the fraction portion of the exam.

Figure 1
Sample Compentency Exam

Do the following problems. You need to get 90% correct to pass this exam. Write your answers next to each problem. If the problem has a decimal in it, leave your answers in decimal form. If the problem has fractions, leave your answer in mixed number form. Calculators are NOT allowed for this exam.

1.) $45 + 2334 + 987$	11.) $13.8 + 100.4 + .023$
2.) $10006 - 7997$	12.) $149.32 - .612$
3.) 522×386	13.) $16 - 3 + 3 - (-2)$
4.) $2.4 \times 17 \times .9$	14.) $(-1230) + (-213)(-2)$
5.) $25.654 \div 1.27$	15.) $4 - 6(2 - 4) + (-2)(7)$
6.) $19091 \div 17$	16.) $15 \times (-6) \times (-4)$
7.) $4 + \frac{1-6}{2-1}$	17.) $4(7 - 3) - 6(2 - 7)$

4

Gaps in Understanding

The errors that the students make can primarily be attributed to a lack of conceptual understanding of fractions. Listed are some typical comments made by students enrolled in math courses for Elementary Education majors. These comments indicate a gap in the understanding of fractions and indicate typical error patterns made by students at all levels.

Q Explain why $\frac{7}{2} = 3\frac{1}{2}$.

A: $3 \times 1 + 2 = 5$ so the answer should be $\frac{5}{2}$

Q Place the appropriate symbol, <, >, or = to make this expression true: $\frac{3}{7}$? $\frac{1}{2}$

A: $\frac{3}{7} > \frac{1}{2}$ because $7 > 2$ and/or $3 > 1$

Q Which yields the larger answer? $15 \times \frac{3}{5}$ or $15 \div \frac{3}{5}$ Explain your answer.

A: $15 \times \frac{3}{5}$ because, you always get a larger answer when you multiply as dividing up something makes it smaller.

Q Solve this problem: $\frac{2}{3} + \frac{1}{2}$

A: $\frac{2}{3} + \frac{1}{2} = \frac{3}{5}$ or the 2's cancel out and the answer would be $\frac{1}{3}$.

Q Show that $\frac{2}{3} = \frac{12}{18}$.

A: $\frac{2}{3} = \frac{6}{18}$ because $6 \times 3 = 18$ so the given problem is incorrect.

Q Rename $\frac{3}{8}$ to an equivalent fraction. Explain your answer.

A: $\frac{3}{8} = \frac{3}{16}$ because you can multiply the denominator by 2

A: $\frac{3}{8} = \frac{6}{8}$ because you can multiply the numerator by 2.

OTHER ANSWERS:

- I have NO IDEA! Just tell me step by step what to do and I'll memorize it!
- I can't do fractions! Why can't we just use a calculator?
- I can't remember when you get a common denominator — add, or multiply?

These remarks indicate that student understanding or lack of understanding is often from an algorithmic standpoint rather than a conceptual one. Many of these errors are easily avoidable if the student has a conceptual understanding of fractions instead of memorizing rules and procedures. These adult students demonstrate that just as like school-aged children, rules and procedures are often forgotten or improperly applied.

One of the goals of the Mathematics for Elementary Teachers classes is to give potential teachers the tools they need to teach concepts rather than algorithms. Manipulatives are used extensively when teaching concepts. These include fraction bars, Cuisenaire rods, pattern blocks, two color counters, and paper to fold. When students have completed the math class for elementary majors, many positive comments result from students who had to relearn fractions. Students indicate that if they were given a conceptual approach when learning fractions in elementary school, they would not be as mathematically illiterate as they are today. They also indicate an enjoyment of the material, mainly because they understood it and did not use just the skills to compute fractions.

The Basics

Many methods such as using models, activities, inquiry questioning, and discourse can be used to help students develop conceptual understanding. Fractional concepts that must be addressed include the following:

Mathematical definition of a fraction

A fraction is a number whose value can be expressed as the quotient of $\frac{a}{b}$ where a and b belong to the set of integers and $b \neq 0$.

Relationships among numbers

- The WHOLE or UNIT
- Fractions as parts of whole
- Location of fractions on the number line
- Division of whole numbers
- Part of a collection: $\frac{a}{b}$ is a out of b equivalent parts
- Relative size of fractions
- Equivalent fractions
- Ratio (a:b)

Representation of the Fraction

- Part/Whole Comparison where a is the numerator (which counts and tells the number of parts under discussion) and b is the denominator (which shows the relative size of the parts): $\frac{a}{b}$
- Fraction to symbolize a ratio (a:b)

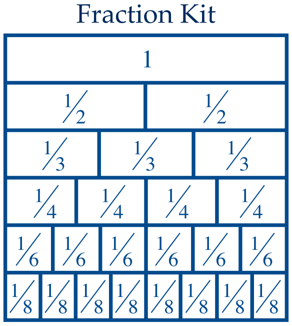
Teaching Basic Concepts

In order to understand basic concepts, students need hands-on activities that provide a mental picture to enable the student to conceptualize the abstract. The fraction kit is a tool that aids students in "seeing" a model of the concept to be taught. An example of the fraction kit is in Figure 2. The following activities will aid in teaching the above concepts.

Make a FRACTION KIT

- This is made with equal size strips of paper, using a different color strip for each denominator. Fold strips of paper into halves, thirds, fourths, sixths, eighths and cut and label each piece. Each student should make his/her own fraction kit. Although the fraction kit will not be exact, students need to make their own kit so they can mentally construct their own insights of the concept under discussion. (Figure 2) Commercial fraction kits are available to use on a regular basis to teach and reinforce these concepts.
- Refer to the strip of paper cut into 2 EQUAL parts labeled $\frac{1}{2}$. The fraction $\frac{1}{2}$ has a numerator (top number) and denominator (bottom number), which are like codes that tell the relative sizes of the parts and the units.
- Look at the fraction kit and think of the numerator as a counting number (how many) and the denominator as the relative size of the parts.

Figure 2
Fraction Kit



Activities using the Fraction Kit

Objective: Teach concepts of relationships among numbers, multiple representations of fractions and definition of fractions

Cutting a Candy Bar

Let each strip of the fraction kit represent a candy bar cut into different pieces. Look at the fraction kit to answer these questions:

- Which part of the fraction kit represents a candy bar that has not been cut?
- If you eat one of the pieces labeled $\frac{1}{3}$, what does the number 1 mean in the fraction $\frac{1}{3}$?
- If Susie ate 4 of the 6 pieces of the candy bar cut into 6 pieces, how could you express this as a fraction?
- What does the number 5 mean in the fraction $\frac{5}{8}$? What does this mean in relationship to the candy bar?
- What would $\frac{2}{6}$ mean?
- What does the number 3 mean in these 2 fractions? $\frac{3}{4}$ and $\frac{2}{3}$
- How many pieces of the candy bar labeled $\frac{1}{2}$ does it take to make a whole candy bar? $\frac{1}{4}$? $\frac{1}{6}$? Justify your answer using the fraction kit.
- Name other pieces of the same size in the fraction kit that can make up a whole candy bar. Justify your answer using the fraction kit.
- Name other candy bars that could be added to the fraction kit and cut into equal size pieces. Justify your answer using the fraction kit.

Can You Verify This?

1) Equivalent parts and renaming fractions

- Use the fraction kit to verify that $\frac{1}{2} = \frac{2}{4}$ and explain your reasoning.
- Use the fraction kit to express different names for $\frac{1}{2}$, $\frac{1}{4}$, $\frac{2}{3}$, $\frac{3}{4}$ and verify your answer.

2) Comparing and Ordering Fractions

- Use your fraction kit to determine how the size of the denominator affects the size of fractional parts of the same whole. Show an example. (Take one piece of the 4-candy bar and one piece of the 3-candy bar, $\frac{1}{4} < \frac{1}{3}$ because the first candy bar is divided into 4 parts and the second candy bar into 3 parts, therefore the one with three parts has the larger pieces.)

- Which is larger $\frac{1}{8}$ or $\frac{1}{6}$? Verify your answer.
- Which is larger? Verify your answer.

  $\frac{5}{8}$ or $\frac{4}{6}$ $\qquad$ $\frac{5}{6}$ or $\frac{2}{4}$
- Using the fraction kit, place these fraction pieces in order from greatest to least. Verify that this is the correct order

  $\frac{2}{3}, \frac{3}{4}, \frac{1}{8}, \frac{1}{6}$
- If the number line below represents a length from 0 to 1, place these fractions in the appropriate place on the number line:

  $\frac{2}{3}, \frac{3}{8}, \frac{1}{6}, \frac{1}{2}$

(Solutions will be approximations.)

3) Express the Whole

- Using the pieces of the fraction kit show different ways to express the whole or ONE. Verify your answer.

  Example: $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{8} = 1$

Understanding Relationships

Tools available for representing fractional concepts include AREA models such as pattern blocks, fraction circles and paper for folding, DISCRETE or SET models such as two colored counters or individual objects, and LINEAR models such as fraction kits, Cuisenaire rods and number lines. The use of multiple representations provides a permanent record of mathematical activity, a way to communicate with others, opportunities for flexible thinking, and helps students get a mental picture of the situation under discussion. Activities using some of the tools to teach the concept of the whole (different ways to express the whole), relationship of parts, and relative size are listed below. Linear, Area and Discrete or Set models are used.

Linear Models

- Let the Brown Cusineaire rod represent the whole or one.

   = 1

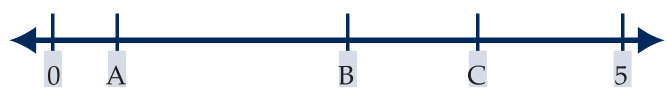
  Using the other rods, draw or show $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{3}{8}, \frac{3}{4}$. Verify that each rod is the fractional part given. Why is the red rod larger than the white rod?

- Let the dark green Cuisenaire rod represent $\frac{3}{4}$, what rod would represent one?

   $= \frac{3}{4}$

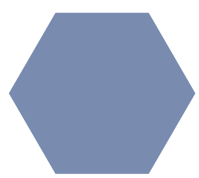
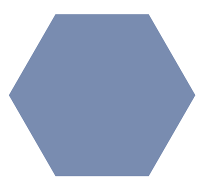
- Place $\frac{2}{3}, \frac{1}{2}$ and 1 on the number line below using the best approximation.

- What value do you estimate A, B, and C on this number line to be?

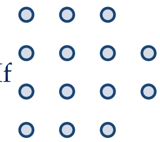


Area Model

Use pattern blocks to find the solution.

- If  = 1, Draw or show $\frac{1}{3}, \frac{1}{2}, \frac{1}{6}$
- If  $= 1\frac{1}{2}$, Draw or show 1, $\frac{1}{2}$
- What fractional part is one green triangle of the figure? Justify your answer.
- What fractional part is one red trapezoid of the figure? Justify your answer.

Set or Discrete Model

- If  $= 1\frac{3}{4}$, Draw or show 1, $\frac{1}{2}$ What functional part are 2 circles? 6 circles?

Conceptual Understanding

Students must make sense of learning by reflecting and communicating mathematical ideas and concepts. Understanding occurs when students can see relationships and connect to other known ideas, and explain and justify ideas. Sample activities to promote or assess conceptual understanding are shown below. When these opportunities are given, conceptual understanding can follow. For example:

- Explain why $\frac{2}{3} = \frac{6}{9}$
- Explain why $2\frac{1}{3} = \frac{7}{3}$.

Compare the fractions given by inserting a > or < sign to make the expression true. DO NOT use the fraction kit, cross multiplication, or a common denominator. Communicate this information using several different representations to justify the answers. Include pictures, models, and/or descriptions, as necessary. ALL of the following questions are appropriate for the examples below, however, they are important for the example next to them.

$\frac{1}{4}$	$\frac{1}{5}$	Are numerators the same?
$\frac{7}{12}$	$\frac{7}{12}$	Are denominators the same?
$\frac{2}{9}$	$\frac{1}{4}$	Rename one fraction.
$\frac{4}{10}$	$\frac{7}{12}$	Relationship to one-half?
$\frac{7}{11}$	$\frac{2}{7}$	Relationship to one?

Conclusion

Students need a strong understanding of basic ideas or concepts before step-by-step procedures and manipulation of symbols (algorithms) are taught. "Students should come to view algorithms as tools for solving problems rather than the goal of mathematical study." (NCTM, 2000, p. 144) Reflected in this paper are gaps in understanding of fraction concepts exhibited in our work with college students. Based on this, we believe many K-12 students are still taught ONLY the algorithm or skill and have no conceptual understanding.

The essential features of teaching and learning mathematics are as follows: a) challenge students to think and reason about mathematics, b) make sense of mathematical ideas, c) use the ideas to model and solve problems and d) communicate the results. Students need opportunities to reflect and communicate mathematics by sharing thinking, asking questions, explaining and justifying ideas, inventing new ideas, finding relationships, making connections, transferring learning to other situations, and constructing insights into the structure of mathematics. The problems listed in this paper (Cutting a Candy Bar, Can You Verify This? Linear Models, Area Models, Discrete Models, and Comparing Fractions) are examples that give students the opportunity to understand relationships, verify solutions and create their own conceptual understanding. The reader is encouraged to reflect and research to generate other activities to address this area of concern in mathematics education. ■

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DEPARTMENT

Math Alive! CAMT 2005

Engaging Hearts and Minds
July 11 – 13, 2005

CAMT 2005 will be held July 11-13, 2005, at the Adams Mark Hotel in Dallas, Texas. Program Co-Chairs are Barbara Holland and Michelle King. Registration and program information will be available online in spring 2005 at:

http://www.tenet.edu/camt/

Kay Tolliver of the Eddie Files will be the featured luncheon speaker.

FEATURES

Recommended Readings and Resources

The Excellent 11 by Ron Clark

After publishing the *New York Times* bestseller *Essential 55*, award-winning teacher Ron Clark took his rules on the road and traveled to schools and districts in 49 states. He met all kinds of amazing people -- involved in bringing up great kids. In the best of these people, he noticed the same qualities that he'd observed in so many of the teachers, children, and parents he'd worked with during his time teaching. These are the qualities he describes in *The Excellent 11*. Ron Clark pinpoints what it takes to make a great student -- and shows that the qualities apply to both educating children and becoming a great teacher. You'll find out what the characteristics are, why they work, and how you can incorporate them into your classroom.

The Excellent 11
by Ron Clark
ISBN 1-4013-0141-X

2004 Award Recipients

TCTM Leadership Award

Honored for her service in mathematics education in Texas to improve professional development and empower teachers to provide the best teaching environment for all students, **Dixie Ross** of Pflugerville ISD received the 2004 TCTM Leadership Award. Dixie has been instrumental in the writing and design of resources such as A Lighthouse Initiative for Texas Mathematics Classrooms and the Laying the Foundation series. She is passionate about providing educators with knowledge and understanding of effective teaching strategies so that teachers will be successful and students will maximize their potential. She was recognized for her contributions to the improvement of mathematics education in Texas at the 2004 CAMT luncheon in San Antonio.


Dixie Ross

TCTM E. Glenadine Gibb Achievement Award

Honored for her service in mathematics education at the state and national level to empower teachers to provide the best teaching environment for all students, **Jacqueline Weilmuenster** of Grapevine-Colleyville ISD received the 2004 E. Glenadine Gibb Award from the Texas Council of Teachers of Mathematics. Jacqueline served as CAMT board president from 2000 to 2004. She has been a writer for state lead curriculum projects and leads her district to continuously refine and improve their mathematics curriculum. Her sensitivity for others and passion for education are an inspiration to many in the state. She was recognized for her contributions to the improvement of mathematics education in Texas at the 2004 CAMT luncheon in San Antonio


Jacqueline Weilmuenster

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

The Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST) identifies outstanding mathematics and science teachers, kindergarten through 12th grade, in each state and the four U.S. jurisdictions. These teachers serve as models for their colleagues and leaders in the improvement of science and mathematics education. The 2004 Texas nominees are:

- **Jack Yaeger** is a 6th grade teacher at Scott Johnson Middle School in McKinney ISD.
- **Mary K. Hernandez** is a 5th grade teacher at Lago Vista Elementary School in Lago Vista ISD.
- **Kathy J. Skinner** is a 5th grade teacher at Samuel Beck Elementary School in Northwest ISD.

The 2004 PAEMST Awardees will be announced at the beginning of April 2005. Each Presidential Awardee will receive a $10,000 award from the National Science Foundation. Each award recipient will also be invited to attend, along with a guest, recognition events in Washington, D.C. during the week of April 11-16, 2005. These events will include an award ceremony, a Presidential Citation, meetings with leaders in government and education, sessions to share ideas and teaching experiences, and receptions and banquets to honor recipients.

The competition alternates each year between teachers of grades K-6 and teachers of grades 7-12. The nomination form for 2005 (7-12 teachers) can be downloaded at :

http://www.paemst.org/2005_Nomination_Form.pdf

Nomination forms must be submitted to Paula Moeller at the Texas Education Agency prior to the application being sent to qualified candidates. Email her at *<Paula.Moeller@tea.state.tx.us>* if you would like to nominate a colleague.

2004 Award Recipients

TCTM Mathematics Specialist Scholarship

Four Texas students were awarded the $1500 TCTM Mathematics Specialist Scholarship for 2004-05.

Nancy L. Thompson

Nancy L. Thompson

I am a senior at Angelo State University pursuing a double major in Math and Computer Science with a secondary teaching certification. I will be student teaching spring '05 most likely in the San Angelo Independent School District. (The exact assignment will not be made until late fall.) My expected graduation date is May '05. I am a member of PI Mu Epsilon (fall '03) and a member of Alpha Chi (fall '02).

Rachel Grubb

Rachel Grubb

I am a student at Baylor University. I will most likely spend one semester student teaching at the upper elementary level (grades 4-5), and I will spend the other semester with grades 6-8. For the fall semester, in addition to student teaching, I will be taking 3 courses: a math class, a class focusing on teaching Gifted/Talented students, and a preparation course for a student teaching abroad experience. At the end of the fall semester, I will be going to Australia for a month to observe and teach middle school math in a suburban school just outside Brisbane.

Debbie Bolin

Debbie Bolin

I am a student at Sam Houston State University, and will be taking method classes in Fall 2004. I plan to complete my student teaching in the spring. I will be certified in K-8 Math, with an ESL endorsement. I plan to teach middle school students in the Spring/Klein area north of Houston.

Adam Normand

Adam Normand

I am a student at Abilene Christian University and will be student teaching in Fall 2004. I will seek licensure to teach mathematics in grades 8-12. I have a pedagogical interest in the use of technology in the mathematics classroom and wrote my senior paper on how technology in algebra, geometry, precalculus and mathematical modeling could enhance student learning.

TCTM CAMTership

Four $300.00 CAMTerships were awarded this past summer by TCTM. We would like to extend our congratulations to **Michael J. White** of Abilene, **Cheryl Ann Schmidt** of Lamesa, **Holly Olson** of Seguin, and **Suzanne B. Perez** of Beeville. All recipients volunteered two hours of their time at CAMT and attended the annual TCTM Business Meeting and Breakfast as guests of TCTM. If you are a member of TCTM, have not attended CAMT before, and have been teaching for five or fewer years, look for the CAMTership application in this Texas Mathematics Teacher on page 22. The CAMTership is intended to encourage beginning teachers to attend CAMT by helping cover part of the expenses associated with attending the conference.

TCTM CAMTership Application

Deadline : May 1, 2005

Eligibility: Six $300 CAMTerships will be awarded to teachers with five or fewer years teaching experience who are members of TCTM and have not attended CAMT before. CAMTerships will be awarded to teachers in each of the following grade levels: K - 4, 5 - 8, and 9 - 12. Winners will be determined by random drawing of names and will be notified by June 1, 2005. Winners will be asked to work for two hours at registration or the NCTM material sales booth and will be TCTM's guest at our breakfast, where the checks will be presented. Good luck!

Name: Last | First | Middle

Address: Number and street | Apt. number

City | State | Zip Code

Contact: ( ) Home Phone | ( ) Work Phone | Email Address

Affiliation: Distrcit or Professional Affiliation | ESC

Are you a member of TCTM? Y N
note: If you are not a member of TCTM, you must enclose a $13 check with this application to apply for membership.

Have you attended CAMT before? Y N

How long have you been teaching?

Describe your teaching responsibilities.

Send your completed application to:

by mail: **Cynthia Schneider,**
234 Preston Hollow,
New Braunfels, TX 78132

by fax: **(512) 232-1855**
ATTN: Cynthia Schneider

by email: ***<cschneider@mail.utexas.edu>***

TCTM Glenadine Gibb Achievement Award Application

Deadline: May 1, 2005

Eligibility: The E. Glenadine Gibb Achievement Award is presented to someone nominated by a TCTM member to be honored for his/her contribution to the improvement of mathematics education at the state and/or national level.

Information about the **TCTM member** nominating a candidate

Name: Last | First | Middle

Address: Number and street | Apt. number

City | State | Zip Code

Contact: ( ) Home Phone | ( ) Work Phone | Email Address

Affiliation: Distrcit or Professional Affiliation | ESC

Are you a member of TCTM? Y N

Are you a member of NCTM? Y N

Information about the **nominee**

Name: Last | First | Middle

Address: Number and street | Apt. number

City | State | Zip Code

Contact: ( ) Home Phone | ( ) Work Phone | Email Address

Affiliation: Distrcit or Professional Affiliation | ESC

Is the nominee a member of TCTM? Y N

Is the nominee a member of NCTM? Y N

Is the nominee retired? Y N

- ☐ Completed application form
- ☐ One-page, one-sided, typed biographical sheet including:
  - Name of nominee
  - Professional activities
  - National offices or committees
  - State TCTM offices held
  - Local TCTM-Affiliated Group offices held
  - Staff Development
  - Honors/awards
- ☐ One-page, one-sided essay indicating why the nominee should be honored for his/her contribution to the improvement of mathematics education at the state/national level

Please submit the completed application, biographical sketch, and essay

by mail: **Cynthia Schneider, 234 Preston Hollow, New Braunfels, TX 78132**

by fax: **(512) 232-1855 ATTN: Cynthia Schneider**

by email: *<cschneider@mail.utexas.edu>*

Reform and Traditional Instruction:

Are students in a reform mathematics class ill-equipped for traditional mathematics instruction?

There are many challenges in reforming one's mathematics instruction in order to teach for understanding. One challenge that prevents some teachers from fully embracing reform mathematics instruction is anxiety about what will happen to their students when they go on to the next grade and enter a more traditional classroom[1]. Many teachers believe that students who learn in a reform mathematics class will be ill-equipped for traditional instruction. As someone who embraces reform mathematics, I too have been concerned about what happens to children who graduate from a reform classroom and move on to a traditional classroom. My greatest concern is that students in a traditional classroom are not learning the mathematics they should be learning. However, I have also been concerned that students who learn math with understanding may not be equipped to handle traditional mathematics instruction. I recently had an experience which has alleviated this concern.

I volunteer once a week in a second and third grade class. My ultimate vision of reform mathematics instruction is demonstrated in this classroom. Children use their own strategies as they engage in tasks that are developmentally appropriate and mathematically relevant. Children communicate their ideas verbally and symbolically with each other and with the teacher. The teacher bases her instructional decisions on her knowledge of individual children's mathematical understandings. She knows an incredible amount about each of her student's mathematical thinking. Her classroom is a place where the children and adults are constantly learning.

Recently when I arrived to volunteer, Ms. B, a substitute teacher, greeted me. I briefly introduced myself and asked if I might stay. Ms. B welcomed me and asked me to work with Delia, who was having trouble settling down. Delia and I sat in a quiet corner of the room and worked for about ten minutes; my back was to the rest of the class as I focused on my work with her. Ms. B had given the children a commercially produced worksheet of 61 problems to solve. The first 40 problems were addition number facts. Fourteen two-digit plus two-digit problems appeared next. The last seven problems were three-digit plus three-digit problems. Some problems required regrouping, others did not.

Once Delia had settled down to work on her own, I looked at the rest of the class. I was stunned. All the children were quietly and independently working on this traditional worksheet. Ms. B was circulating through the room and offering brief words of encouragement. I am often surprised by what happens in this class; however, in my twelve years of being there, I had never seen the children work on a traditional worksheet. I had also not seen the class so quiet. Although children often solve problems independently, once they have solved a problem they usually talk with someone else about their solution. I stood there for about five minutes and just watched. Aside from the students being seated at tables and having a lot of interesting materials in the room, I could have been watching a traditional mathematics class. Suddenly Tessa got up to get base ten materials and I was pulled out of my reverie.

The children continued to complete the worksheet in a relaxed and unusually quiet fashion. Three more children eventually got base ten materials. Three other children got some paper to help them keep track of

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[1] Providing complete definitions of reform and traditional mathematics classes is complex and beyond the scope of this paper. In order to help you understand my perspective, I provide two skeletal definitions.

In reform classrooms: students are expected to develop strategies to solve problems; students share their thinking with each other and the teacher; teachers understand their students' mathematical thinking; and students' thinking is the main factor teachers consider when making instructional decisions.

In traditional classrooms: teachers demonstrate strategies or present concepts for students to learn; students are expected to use the strategies that have been demonstrated to the class; teachers assess the extent to which students can use demonstrated strategies; helping students adopt standard strategies is a major factor teachers consider when making instructional decisions.

their solution strategies since there was no room on the worksheet to write anything except answers. After 25 minutes all but two of the third graders and over half of the second graders had completed the worksheet. By the end of the class only two children had not completed the worksheet. Two-thirds of the class got 95% or more of the problems correct. The remaining third of the class included the two children who did not finish. All of the children who finished got 85% or more of the problems correct. Both of the children who did not finish had gotten two incorrect answers so far; one had ten problems yet to do and the other had 14 problems yet to do.

If I had continued to watch from afar and had not known this class, I might have assumed that the children were all practicing the standard addition algorithm, with the exception of the children who got base ten materials. There were, however, four significant ways in which this classroom was very different from a traditional classroom. First was the children's approach to this task. Although this worksheet contained nothing to encourage problem solving, all the children approached it as a problem-solving task. It never occurred to them to view this as busy work to rush to complete. They saw this worksheet as a task to engage in with understanding. They did not look to the teacher to tell them how to complete it and no one asked the teacher or me if an answer was correct.

A second way in which this class differed from a traditional class was the strategies the children used to solve these problems. Although their teacher does not teach standard algorithms, many children have been exposed to standard algorithms by their parents or older siblings. Six children used, or tried to use, the standard addition algorithm for some of these problems. Three children used the algorithm correctly. Three other children tried to use the algorithm, but used it incorrectly and got incorrect answers for the problems on which they used it. It is worth noting that no child used the standard algorithm on all of the multi-digit problems; all of the children used informal strategies to solve at least some of the multi-digit problems. Since the children are used to explaining their thinking to me, many of them came to me to tell me how they had solved a problem. Here are some of the strategies children shared with me.

$$\begin{array}{r} 802 \\ +\,952 \\ \hline \end{array}$$

Tessa: First I made 802. (She takes 8 hundreds flats and 2 ones cubes from a container of base ten blocks.) Then I made 952. (She pulls out 9 flats, 5 tens bars and 2 ones cubes from the container.) I counted, "800 (starts pulling aside hundreds flats from the 952), 900, ten hundred, eleven hundred, twelve hundred, thirteen hundred… seventeen hundred. Then seventeen hundred ten, (starts pulling the tens from what was the pile of 952) seventeen hundred twenty, seventeen hundred thirty, seventeen hundred forty, seventeen hundred fifty, seventeen hundred fifty four. (Writes 1754 on her paper.)
Ms. L: Is there another way to say that number?
Tessa: Yes, one thousand seven hundred fifty-two.

$$\begin{array}{r} 39 \\ +\,38 \\ \hline \end{array}$$

Michael: Nine and eight is 17. 30 and 30 and 10 is 70. 7 more is 77.

$$\begin{array}{r} 470 \\ +\,480 \\ \hline \end{array}$$

Nate: 400 + 400 is 800. 70 plus 80 is 150. 800 plus 100 is 900. 900 plus 50 is 950.

$$\begin{array}{r} 534 \\ +\,640 \\ \hline \end{array}$$

Allison: Four plus zero is four. Four plus three is seven; so 40 and 30 is 70. 74. 500, 600, (extends one finger for every count) 700, 800, 900, 1000, 1100. 500 + 600 is 1100. So 1174.

$$\begin{array}{r} 534 \\ +\,640 \\ \hline \end{array}$$

Crystal: 500 plus 500 is 1000 plus another 100 is 1100. (Writes 1100 +) 30 and 40 is 70. (Writes 70 + 4 so she has 1100 + 70 + 4 written down.) It's 1174.

$$\begin{array}{r} 802 \\ +\,952 \\ \hline \end{array}$$

Tyrone: Eight and nine is 17, so 800 plus 900 is 1,700. 50 + 4 is 54, so 1754.

$$\begin{array}{r} 724 \\ +\,635 \\ \hline \end{array}$$

Kate: Six plus six is 12, so 600 plus 600 is 1,200. I have another hundred left so 1,300. 20 plus 30 is 50 and 4 is 54 plus 5 is 59. 1,359.

62 + 53

Andy: This is ridiculous. Why did they have 62 plus 53 when I just did 53 + 63? (He solved 53 + 63 four problems earlier.) The 53s are the same and 63 is just one more than 62. Since 53 + 63 is 116, this is just 115.

Ms. L: Do you see any others like that?

39 + 38

Andy: (Looks ahead at the problems.) Yes, 54 plus 43 will also be easy. I already did 42 and 52 and got 94. It will be 97 since 54 is 2 more than 52 and 43 is one more than 42. I did 3 more than 94 and got 97.

Although these strategies are good ways to solve these problems, it is worth noting that typically the children use a larger variety of strategies. These children would typically use more strategies like Andy's, which were based on relationships. They would also use some incremental strategies. An example of an incremental strategy for 62 + 53 is, "62, 72, 82, 92, 102, 112, (pause) now I have 3 more, 113, 114, 115." A lack of a variety of strategies might have been due to the fact that these problems were very easy for many of these children. The fact that the problems were written vertically might have also contributed to the narrow range of strategies used.

A third way in which this class differed significantly from a traditional class involved the students who were the least sophisticated in their approach to these problems. In a classroom where the standard addition algorithm is taught, it would be typical to have some second and even some third graders who were not using it correctly. When these children encounter this type of worksheet, they would most likely practice incorrect procedures. Their understanding of mathematics would not improve by working through such a worksheet. The four children in this class who used base ten materials to model the problems were the least sophisticated in their approach to the worksheet. Two of these children didn't finish the worksheet. However, all four of these children were engaged in meaningful mathematics. If you compare Tessa's strategy for solving 802 + 952 with Tyrone's strategy for solving the same problem, you can see that Tessa's current understanding provides a foundation upon which she could build an understanding of strategies like Tyrone's. Children who practice using the standard addition algorithm incorrectly, or children who practice using the standard addition algorithm without understanding, are not developing a foundation for more sophisticated strategies. The four children who used base ten materials to model these problems clearly were developing a foundation for more sophisticated mathematics.

The final way that this class differed from a traditional class had to do with the role the substitute teacher played. She did not interfere with these children's problem solving. She did not demonstrate a procedure and require that children follow it. When she saw children getting base ten materials or using non-standard procedures, she did not interfere. Although she did not foster the development of children's understanding to the same extent that their regular teacher does, she did not hinder these children's use of intuitive strategies.

I firmly believe in teaching for understanding as exhibited in a reform classroom. Even before my observations of these children with the worksheet, I would have chosen to teach this way regardless of children's future instruction. The experience of watching these children work through this worksheet has shown me that worries about children being ill-equipped to handle traditional instruction may be unfounded. What exactly might such children be ill-equipped to handle? It is not the mathematics. Even though these children seldom see worksheets like this, their performance was very good. I think (and hope) that most traditional teachers will allow children to use non-standard strategies to solve a problem as long as they get the correct answer. Perhaps these children will be ill-equipped to cope with a traditional teacher who requires that they adopt a standard algorithm [2]. My guess is that these children would have been bothered by a substitute teacher who had demonstrated a strategy and required that they all use

[2] If this is going to happen to your students, you might want to discuss this issue with them or their parents. The complexities involved in addressing this issue are beyond the scope of this paper.

it. I, however, do not want children to be complacent if they are required to use procedures they may not understand. I do not want them to say, "Oh well, this is what we have to do now, so I guess I will stop thinking and follow directions." Preparing children to adopt others' strategies without understanding is not a good reason to restrain oneself from fully embracing reform mathematics teaching.

Finally, I want to acknowledge that it is very difficult to teach reform mathematics when many or most of the teachers at your school are traditional mathematics teachers. We learn best when we have supportive colleagues with whom to work. Not only do we need emotional support to take risks and try new things, we also need the intellectual support that comes from discussing ideas with our colleagues. It would be hard for me to continue my learning about teaching for understanding if I did not have people with whom to learn. It is also challenging to teach reform mathematics when most of the students entering your class have been conditioned to believe that learning math means practicing the procedures that teachers show you. The transition from a traditional mathematics class to a reform mathematics class is difficult for children and for their teachers. I have several teacher colleagues who deal with this situation at the beginning of the school year, and they tell me it can take three or four months for some students to believe that they can understand mathematics and find their own ways to solve math problems. (Conversely, one has to wonder how quickly a child taught via multiple strategies and problem solving will lose that skill when taught traditionally.) If you are a teacher who is teaching math for understanding within a school where few others are doing so, I admire you. I trust that your students will have lasting benefits from working with you and will be well-equipped to handle whatever instruction they encounter when they leave your class.

■

Linda Levi, Ph.D. • <llevi@facstaff.wisc.edu>
Associate Researcher • University of Wisconsin-Madison

DEPARTMENT

Nominations for TCTM Board

Elections for the following positions will be held in Spring 2005:

- President
- Vice-President Elementary
- Treasurer
- Southeast Regional Director
- Southwest Regional Director
- South Regional Director.

See the state map on the inside cover of this journal for exact geographic areas for each regional director. Nominations should include identification of position sought and a short autobiography explaining the nominee's interests and qualifications. Self-nominations are welcome. If you are nominating someone other than yourself, be sure they have agreed to run for the office for which you are nominating them. Please include current and complete contact information. Submit your documents on or before January 1, 2005 to the current chairperson of the Nominations and Elections committee, Linda Shaub at <lshaub@uteach.utexas.edu>, or 1111 Highland Hills, Marble Falls, TX 78654.

APPLICATION

TCTM Mathematics Specialist Scholarship

Amount: $1500 **Deadline: May 1, 2005**

Eligibility: Any student attending a Texas college or university – public or private – and who plans on student teaching during the 2005-06 school year in order to pursue teacher certification at the elementary, middle or secondary level with a specialization or teaching field in mathematics is eligible to apply. A GPA of 3.0 overall and 3.25 in all courses that apply to the degree (or certification) is required.

Applicant Information

Name: Last ______ First ______ Middle ______

Address: Number and Street ______ Apt. number ______

City ______ State ______ Zip Code ______

Contact: ( ) Home Phone ______ ( ) Work Phone ______ Email Address ______

Personal: Social Security Number ______ Birth Date ______

College Information

What college or university do you plan to attend? If you are awarded this scholarship, TCTM's treasurer will send a check directly to the business office of the college. We need the college's complete address.

Name: College or University ______

Address: Number and Street ______

City ______ State ______ Zip Code ______

You must submit three (3) copies of each of the following documents:

1. Completed application form.
2. One official college transcript and two copies.
3. Two letters of recommendation:
   - One from either a mathematics or mathematics education professor you have taken coursework from and is not related to you.
   - One from a K-12 classroom teacher of mathematics you have worked with recently or that was a former teacher of yours and is not related to you.
   - It required that at least one of these recommendations come from a current member of TCTM, it is preferred that both recommendations come from current members of TCTM.
4. An essay of 1,500 words or more that describes your philosophy of teaching mathematics and how you will implement this philosophy with your future students. Specific examples of how you will teach a mathematics concept are required to illustrate your teaching philosophy. Or you may write an essay that explains a specific mathematics topic or concept, for example, a paper on proportionality.

Please submit all materials in one envelope to:

by mail: **Cynthia Schneider**
234 Preston Hollow
New Braunfels, TX 78132

by fax: **(512) 232-1855**
ATTN: Cynthia Schneider

TCTM Leadership Award Application

Deadline: May 1, 2005

Eligibility: The TCTM Leadership Award is presented to a TCTM member who is nominated by a TCTM Affiliated Group. This person is to be honored for his/her contributions to the improvement of mathematics education at the local and state level. He/she has designed innovative staff development and has promoted the local TCTM Affiliated mathematics council.

Information about the **TCTM member** nominating a candidate

Name: Last / First / Middle

Address: Number and street / Apt. number

City / State / Zip Code

Contact: ( ) Home Phone / ( ) Work Phone / Email Address

Affiliation: Distrcit or Professional Affiliation / ESC

Are you a member of TCTM? Y N

Are you a member of NCTM? Y N

Information about the **nominee**

Name: Last / First / Middle

Address: Number and street / Apt. number

City / State / Zip Code

Contact: ( ) Home Phone / ( ) Work Phone / Email Address

Affiliation: Distrcit or Professional Affiliation / ESC

Is the nominee a member of TCTM? Y N

Is the nominee a member of NCTM? Y N

Is the nominee retired? Y N

Applications should include 3 pages:

- ☐ Completed application form
- ☐ One-page, one-sided, typed biographical sheet including:
  - Name of nominee
  - Professional activities
  - National offices or committees
  - State TCTM offices held
  - Local TCTM-Affiliated Group offices held
  - Staff Development
  - Honors/awards
- ☐ One-page, one-sided essay indicating why the nominee should be honored for his/her contribution to the improvement of mathematics education at the state/national level

Send the completed application, biographical sketch, and essay to

by mail: **Cynthia Schneider, 234 Preston Hollow, New Braunfels, TX 78132**

by fax: **(512) 232-1855 ATTN: Cynthia Schneider**

by email: ***<cschneider@mail.utexas.edu>***

Texas Council of Teachers of Mathematics Membership Form

Applicant Information

Name: Last | First | Middle

Address: Number and street | Apt. number

City | State | Zip Code

Contact: ( ) Home Phone | ( ) Work Phone | Email Address

Affiliation: Distrcit or Professional Affiliation | ESC

Individual TCTM Membership

Cost : $13.00 per year

Membership includes 1 copy of the biannual TMT journal.

Circle area(s) of interest: **K-2** | **3-5** | **6-8** | **9-12** | **College**

Circle one : New Member | Renewal | Change of Address

[ ] year(s) x $13.00 = $

Professional TCTM Membership

Cost : $40.00 per year

For schools, institutions, or affiliated groups. Membership includes 3 copies of the TMT journal.

Circle one : New Member | Renewal | Change of Address

[ ] year(s) x $40.00 = $

National Council of Teachers of Mathematics Membership

Circle one : New Member | Renewal | Change of Address

Full Individual membership includes a print subscription to the NCTM News Bulletin and one NCTM Journal. Select one journal below.

Teaching Children Mathematics	$72
Mathematics Teaching in the Middle School	$72
Mathematics Teacher	$72
Journal for Research in Mathematics Education	$94

Membership Dues $

Additional print journals may be selected to enhance your membership, and includes online access.

Teaching Children Mathematics	$30
Mathematics Teaching in the Middle School	$30
Mathematics Teacher	$30
Journal for Research in Mathematics Education	$52

Additional Journals $

Amount Due NCTM $

Scholarship Donations

TCTM awards scholarships to college students planning to pursue a career in mathematics teaching either as a mathematics specialist in elementary school or as a secondary school teacher with certification in mathematics. Your contributions in any amount are greatly appreciated. Please write a separate check for scholarship donations.

Scholarship Donations $

Make check(s) payable to TCTM and mail to:
TCTM Treasurer
2833 Broken Bough Trail
Abilene, TX 79606

TOTAL AMOUNT DUE $

Texas Council of Teachers of Mathematics
Executive Board 2004 - 2005

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When does YOUR membership expire?

Note the expiration date on your mailing label.
Use the membership form inside to renew before that date.

Texas Council of
Teachers of Mathematics

Member 2004-2005

NAME ___________________________

Texas Mathematics Teacher
234 Preston Hollow
New Braunfels, TX 78132

Return Service Requested