Texas Mathematics Teacher

Volume LXII Issue 1 Spring/Summer 2015

Find the Mathematics...

... in a monument!

see page 15

photos by Cynthia L. Schneider

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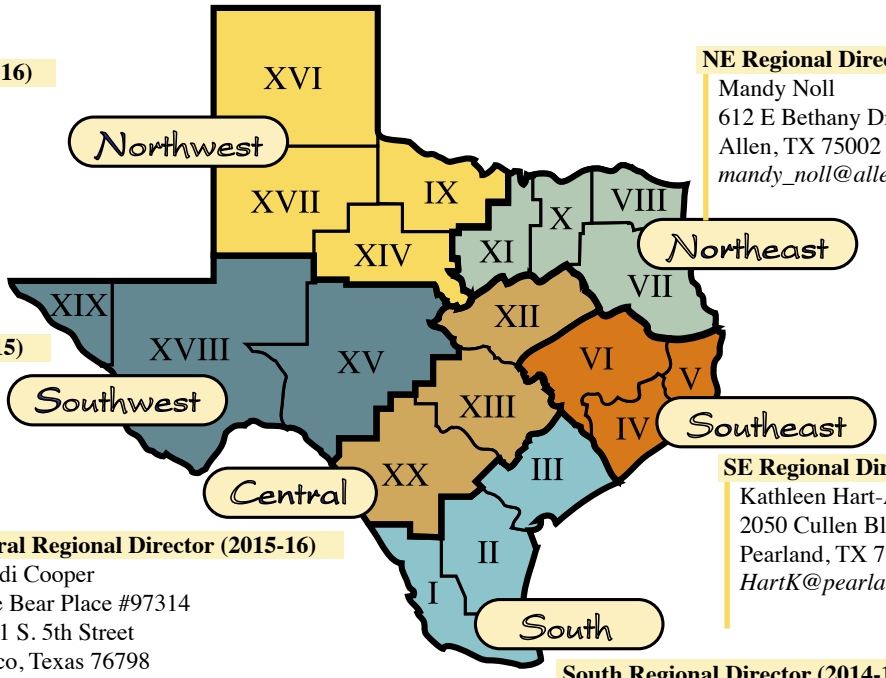

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Texas Mathematics Teacher

A PUBLICATION OF THE TEXAS COUNCIL OF TEACHERS OF MATHEMATICS

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photos by Cynthia L. Schneider

Articles

Features

Departments

TCTM Applications

All applications (including TCTM membership) are available online at <*www.tctmonline.org*>.

Letter from the President

Dear TCTM colleagues,

Let me begin by thanking those who visited with us at the TCTM booth at CAMT 2015. "Thank you" to those who joined or renewed their memberships with us at CAMT also. It was a pleasure to feel the enthusiasm emulated by the math educators who spent part of their "summer off" in the pursuit of quality professional development. We know that "summers off" is just a myth to the majority of highly qualified teachers in the state of Texas. As a parent and fellow educator, I appreciate the amount of personal time and energy that teachers put in to their efforts to provide the best possible education for our children.

A couple of deadlines are quickly approaching for opportunities to members of TCTM. The Writers Retreat, which is scheduled for January 16-18, 2016, is a wonderful opportunity to learn about writing articles for publication in a professional journal. The deadline for application is October 1st. TCTM also offers members the opportunity to apply for a grant up to $1200. The deadline for applying is November 30th, and awards are announced on January 31st. The application process and more information for both opportunities are on the website.

Good luck in the coming school year!

Sincerely,

Martha Godwin
TCTM President
<Marthagodwin78@aol.com>

Website: *<www.tctmonline.org>*

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TCTM Communications

Follow TCTM on Twitter!

Did you know that we now have an official Twitter account? Find out the latest about TCTM and other information just for Texas mathematics teachers!

twitter.com/tctmonline

Follow TCTM on Facebook!

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Snail Mail!

The journal is sent to the address you indicated on your membership form or the address that was used when you registered for CAMT. Please update your mailing address if it is not correct. If you have an e-mail address, please be sure it is on file and up-to-date with TCTM. If you do not have an e-mail address, please let us know. You may update your information online at *<www.tctmonline.org>* .

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@utexas.edu*> so we may publicize your events. Contact information for each group is also available on the NCTM website, <*www.nctm.org*>. Contact information for regional directors is located on the inside front cover of this publication.

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Texas South Plains CTM
Contact: Treasure Brasher, <*tbrasher1@suddenlink.net*>

NORTHEAST REGION
Service Centers 7, 8, 10, 11
Mandy Noll, Regional Director

East Texas CTM
Contact: Martha Godwin, <*mgodwin@qcisd.net*>.

Greater Dallas CTM
Contact: Richard Newcomb, <*RNewcomb@cistercian.org*> .

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Fort Bend CTM
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SOUTH TEXAS REGION
Service Centers 1, 2, 3
Shere Salinas, Regional Director

The South Texas Region is on Project Share! The group is "Texas Council of Teachers of Mathematics: South Region."

Coastal CTM
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CTM @ Texas A&M University at Corpus Christi (Student Affiliate)
Contact faculty advisor Faye Bruun, <*faye.bruun@tamucc.edu*>.

CTM @ Texas A&M University at Kingsville (Student Affiliate)
Contact NCTM Representative: Susan Sabrio

Rio Grande Valley CTM
Contact: Velma Sanchez at <*vesatea10@hotmail.com*>, or visit <*www.rgvctm.org*>.

CENTRAL TEXAS REGION
Service Centers 12, 13, 20
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STATEWIDE

Texas Association of Supervisors of Mathematics (TASM)
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The Association of Mathematics Teacher Educators of Texas (AMTE-TX)
Contact Dusty Jones at <*dljones@shsu.edu*>, or visit < *www.amte-tx.org*>.

NATIONAL

National Council of Teachers of Mathematics (NCTM) visit <*nctm.org*>.

National Council of Supervisors of Mathematics (NCSM) visit <*www.mathedleadership.org*>.

Albert Einstein
(1879 - 1955)

Exploring the Möbius Strip and Other Loops

Background

Many of us have seen the classroom demonstration where a Möbius strip is formed and then shown to have only one side by drawing a continuous line along it. Perhaps we have even seen it cut in half, down the middle, resulting in only one loop. Unfortunately, demonstrations rarely go beyond that, and students are left with a limited exploration of the Möbius strip. But why does the Möbius strip have such unique properties? The answer lies in its single twist, or more accurately, its half-twist.

A Möbius strip can be made by taking a strip of paper, giving it a half-twist, and joining the ends of the strip together to form a loop. A half-twist is defined as the 180° rotation of one of the ends of a strip before the two ends are joined. A whole twist then, is a 360° rotation. A loop is called a Möbius strip only if it has one half-twist. (There are a plethora of videos on the Internet demonstrating the construction of a Möbius strip if a visual is preferred.) As the paper demonstration exhibits, this twist causes the loop to have only one side, and in contrast to when a loop with no twists is cut in half, a Möbius strip produces only one loop when bisected (see Figure 1).

Let us examine why only one loop is produced. In addition to having only one side, the Möbius strip also has only one edge. The two are mutually inclusive, because a loop with one side always has one edge (and vice versa), and a loop with two sides always has two edges (and vice versa). When a Möbius strip is cut in half, the scissors separate the outer "edges," which are actually the same edge, and the edges directly adjacent to the scissor blade are also the same edge, so the resultant loop has two edges. One was the outer edge of the Möbius strip, and the other was the edge created on either side of the scissor blade.

What if a Möbius strip is cut in thirds instead of in half? As shown in Figure 2, the result is two linked loops: the smaller one is a Möbius strip, and the larger one is the result of the previous experiment, that is, a Möbius strip cut in half. Where did each of these come from? The Möbius strip is the middle third of the initial loop, and the larger loop is the two outer thirds. (The outer thirds are one and the same because a Möbius strip has only one edge.) A Möbius strip is one of the resultant loops because this procedure is equivalent to just trimming a Möbius strip for width. The other loop results because this is also equivalent to cutting a Möbius strip in half, but with scissors that remove a third of the paper's width from the middle. Cutting a Möbius strip in half and in thirds is thus not so different.

Handedness

Another important attribute of the Möbius strip is the often-overlooked characteristic of handedness. An example of handedness is the thread direction on a nut and bolt. A bolt whose threads spiral to right will not fit a nut whose threads spiral to the left and vice versa. Similarly, a Möbius strip has two forms: a right-hand Möbius strip and a left-hand Möbius strip (see Figure 3). What each form is called is not important, as long as there is a distinction. For this article, when the two ends of a strip are brought together, a right-hand Möbius strip is defined when from the point of view of one end, the half-twist is made clockwise, and a left-hand Möbius strip is defined when the half-twist is made counterclockwise (see Figure 4). The result of right and left hand Möbius strips being cut in the same fashion yields loops that are mirror images of each other, but when they are combined with other loops, the results are quite surprising.

Figure 1

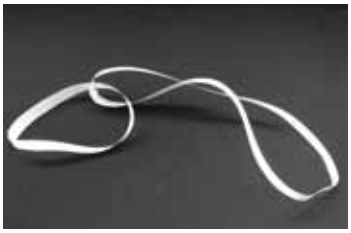


Figure 2

Figure 3

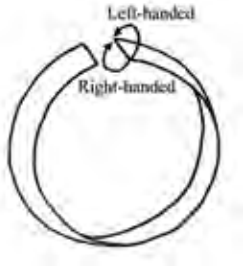


Figure 4

Let's start simple. Take two loops without any twists, and tape them together at a 90° angle (see Figure 5). Then cut them both down the middle. The result is a square (see Figure 6). Surprised yet? Now try the same thing, but with one untwisted loop and a left- or right-hand Möbius strip (see Figures 7 and 8). The result is also a square! But what if the loops are not taped together at 90°? What about 45°? When this is done with two untwisted loops, the result is, as expected, a rhombus with two 45° angles and two 135° angles (see Figure 9). But when done with an untwisted loop and a Möbius strip (of either hand), the result is a curious figure which will not lie flat and in which the 45° angles are adjacent, rather than opposite each other (see Figure 10). Therefore, the only reason why two untwisted loops or one untwisted loop and a Möbius strip when taped together at 90° and cut in half both produce a square is because the figure is the same no matter where each particular angle is (since every angle in a square is 90°). But when they are not taped together at 90°, the resulting figure's angles arrange themselves differently depending on whether the loop is a Möbius strip or not.

Figure 5

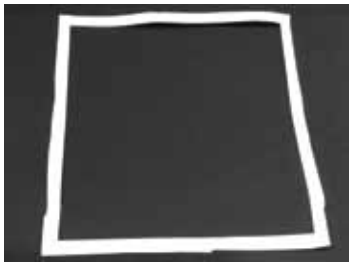


Figure 6

Figure 7

Figure 8

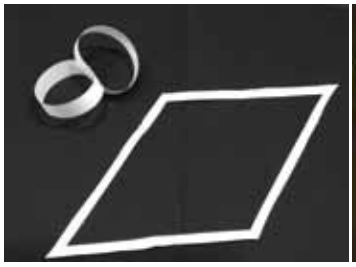


Figure 9

Figure 10

The outcomes get even more interesting when two Möbius strips are taped together, and this is where handedness comes into play. When two right-hand Möbius strips are taped together at right angles and cut down the middle, two peculiar figures are produced (see Figure 11). One is similar to an ellipse with corners, and the other is a twisted, goggle-like shape. The same happens with two left-hand Möbius strips except for the results being a mirror image of their right-handed counterparts. But when a left-hand and a right-hand Möbius strip are taped together and cut as such, the result is a pair of linked hearts. How sweet! (See Figure 12)

Figure 11

Figure 12

Connections to Loops of Higher Twists

The Möbius strip has been thoroughly explored with itself and loops of zero twists, but when loops with two or more half-twists are considered, the possibilities grow exponentially. Perhaps there is a way to predict the products of higher-twisted loops mathematically. Simple experimentation yields the following statements:

For any loop with n half-twists that is cut in half,

> If n is even, the result is two loops, each with n half-twists.
>
> If n is odd, the result is one loop, with $2n + 2$ half-twists.

In both cases, the resultant loops always have the same handedness as the initial loop, and except for the case of $n = 0$, resultant loops of an even number of twists are always linked. Thus, according to our statements, the resultant loop of a Möbius strip has four half-twists ($2 \bullet 1 + 2 = 4$), and for the initial loop of $n = 5$, the result is a loop of $2 \bullet 5 + 2 = 12$ half-twists. Another important aspect is that when n is odd, the initial loop has one side, and when n is even, the initial loop has two sides.

Remember the demonstration that yielded a square? What if we repeat the experiment, but replace the Möbius strip with a higher-twisted loop? Quite surprisingly, a loop of zero twists and a loop of two half-twists when taped together at right angles and cut down the middle, also yields a square. In fact, when a loop of zero twists is combined in such a way with a loop of any number of twists, the result is always a square. The reason behind this is easier to see by working backwards. Start with a square, and tape the corners together so there are two half-width loops connected by a single strip, so that it looks like a pair of handcuffs. Now join the half-width loops together after giving the connecting strip one, two, three, or more twists. A square can always be formed into a loop of zero twists and a loop with any number of twists. In addition, when the loops are not taped together at right angles, the result is a rhombus (Figure 9) when the twisted loop has an even number of half-twists, and the result is the "curious" shape (Figure 10) when the twisted loop has an odd number of half-twists.

Connections to Higher Dimensions

In topological terms, a Möbius strip is a two-dimensional bounded surface that can exist only in at least three dimensions without self-intersections. A cousin of the Möbius strip, called the Klein bottle, is also a two-dimensional surface but requires at least four dimensions to exist without self-intersections. Figure 13 is a glass, three-dimensional immersion of a Klein bottle. It is a cylinder that curves up and around, then passes inside itself and joins with the other end at the bottom. Notice the place where the neck of the bottle passes through itself; this is a self-intersection, which is why a true Klein bottle can exist only in at least four dimensions.

Figure 13

Like the Möbius strip, however, the Klein bottle has only one side, and consequently, zero volume because the inside is the same as the outside. What's more interesting is that a Klein bottle can be formed from two Möbius strips, one right-hand and one left-hand, by joining their edges together. While this can be extremely hard to visualize with regular looking Möbius strips (as in Figure 3), it is much easier when the strips are already cut to look like a Klein bottle. In Figure 14, two Möbius strips have each been cut to look like half a Klein bottle. It does not matter that the width is not constant, as long as they are continuous loops with one half-twist. If these two Möbius strips were put together in the fourth dimension, the result would be a Klein bottle.

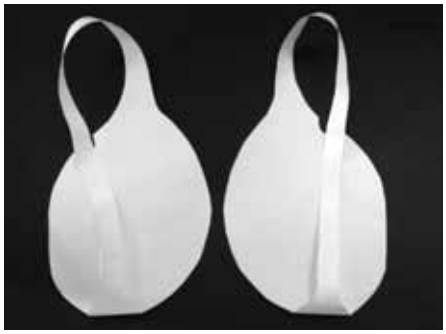


Figure 14

Teaching Activities

Careful thought must be used when teaching about the Möbius strip in order to effectively communicate its unique properties. Unfortunately, many lessons available on the Internet are deficient in such thought. For example, many of these ask students to cut a Möbius strip in half and then cut the resultant loop in half again. This practice not only makes the paper uncomfortably narrow to work with, but also stresses that two linked loops with four half-twists each are the result of cutting a Möbius strip in half twice, rather than the result of cutting a four half-twist loop in half once. It is more accurate to emphasize that such loops are not necessarily descendants of the Möbius strip, but can be formed in different ways. In addition, very few lessons mention handedness at all, but as we have seen in the linked hearts demonstration, handedness is critically important.

For middle and high school students, a classroom demonstration should start with forming a Möbius strip and comparing it to an untwisted loop. Show how each has a different number of sides by drawing a line down the middle, and ask students to predict what will happen to each when they are cut in half. Then, if you plan to let students experiment on their own, emphasize the handedness of the Möbius strip. If students are not aware of handedness, they may come up with different results when trying to replicate another student's experiment. The

most important part of a hands-on demonstration, however, is to ensure that students keep a careful record of what loop(s) they started with, and what loops they ended with. Students should record how many twists the loop had, what handedness they were, and how they were combined with other loops. To spark curiosity with bored or apathetic students, suggest they try taping two loops together at right angles. A smile and a "Wow" is guaranteed when one of them discovers the linked hearts. For more advanced students, ask them to develop a formula to predict the products of a loop with a given number of twists when it is cut in half. For a given loop, you can also work backwards to determine what loops, if any, could have produced it. For example, if n = 8, the initial loop had either 8 or 3 half-twists. If n is odd, then no loop could have produced it when cut in half. Activity sheets have even been made for these activities and are provided at the end of this article. The activities are aligned with 2012 high school TEKS 111.39 c 1 G, 111.39 c 4 C, and 111.40 c 8 C.

Conclusion

The Möbius strip is a deceptively simple, but intriguing object. Its myriad of properties and possible outcomes continue to amaze and fascinate the mind. This article though, has merely scratched the surface of what the Möbius strip and its higher-twisted cousins conceal beneath their stark white exterior. There is a world to discover of unexpected results and even other rules to predict what may unfold. It is an eternal challenge to finally realize the grandeur of the Möbius strip.

Activity Sheets

The following activity sheets are designed for students who have taken Algebra 1, although younger students could certainly complete the data-gathering section. Students will derive the two formulas after experimenting with twisted loops, and will predict the initial and resultant loops using those formulas. These should be provided only after a classroom demonstration of the Möbius strip that includes a thorough explanation of half-twists. Students may also have difficulty counting the number of half twists in a resultant loop. To do this, cut the loop apart while holding both ends in place, and carefully lay the loop flat on a table without rotating either end. Then while holding one end stationary, untwist the other end one half-twist at a time, and count the number of half twists. Linked loops that are heavily tangled together can be untangled by cutting one of the loops and carefully passing it through the other loop, while making sure that the two ends are kept parallel and are not rotated.

Judah Lesser • Student
Coronado High School, El Paso, TX •
<judahlesser@hotmail.com>

Answer Key

Finding Formulas for Loops

Initial half-twists	0	1	2	3	4	5	6	7	8
Resultant half-twists	0 each	4	2 each	8	4 each	12	6 each	16	8 each
# of resultant loops	2	1	2	1	2	1	2	1	2

The formulas are:
For any loop with n half-twists that is cut in half,
If n is even, the result is two loops, each with n half-twists.
If n is odd, the result is one loop, with $2n + 2$ half-twists.

Predicting and Deriving Loops

1. 1 loop with 12 half-twists
2. 2 loops with 10 half-twists each
3. 1 loop with 16 half-twists
4. 2 loops with 12 half-twists each
5. 1 loop with 36 half-twists
6. 2 loops with 16 half-twists each
7. 2 loops with 20 half-twists each
8. 1 loop with 64 half-twists
9. 4 or 1 half-twists
10. 10 or 4 half-twists
11. N/A
12. N/A
13. 12 or 5 half-twists
14. 2 half-twists

Name_____ Date_____ Period_____

From: Exploring the Möbius Strip and Other Loops

Finding Formulas for Loops

Fill in the table by making loops with the given number of half-twists, cutting them in half, and recording how many half-twists the resultant loop has. If there are more than one resultant loops, record how many there are and how many half-twists each loop has.

Initial half-twists	0	1	2	3	4	5	6	7	8
Resultant half-twists	0 each								
Number of resultant loops	2								

Using the data in the table, write a formula to predict the number of half-twists in a resultant loop for a given number of half-twists in an initial loop that is cut in half. Be sure to include how many resultant loops there will be. You may need to write more than one formula.

Name_____ Date_____ Period_____

From: Exploring the Möbius Strip and Other Loops

Predicting and Deriving Loops

For exercises 1-8, n represents the number of half-twists in an initial loop. Predict how many half-twists a resultant loop will have when the initial loop is cut in half. Also indicate the number of resultant loops.

Example: $n = 0$

2 resultant loops with 0 half-twists each

1. $n = 5$

2. $n = 10$

3. $n = 7$

4. $n = 12$

5. $n = 17$

6. $n = 16$

7. $n = 20$

8. $n = 31$

For exercises 9-14, n represents the number of half-twists in a resultant loop. Determine how many half-twists an initial loop had that when cut in half, would produce a resultant loop with the given number of half-twists. If no initial loop exists, write N/A.

Example: $n = 8$

The initial loop had either 8 or 3 half-twists

9. $n = 4$

10. $n = 10$

11. $n = 9$

12. $n = 15$

13. $n = 12$

14. $n = 2$

2015 Texas Mathematics Teacher's Writers Retreat

Our second annual Writers Retreat was January 17-19 in Austin. A total of 5 dedicated teachers came together to learn more about writing for the *Texas Mathematics Teacher* and to learn from each other. Over the three-day event we shared stories, spent time writing, talked about teaching and did some mathematics. The topics for our workshops included Copyright, Intellectual Property, Plagiarism, APA Style, Hot Topics, and the Role of the Reviewer. There was plenty of writing time allotted over the weekend and of course we harnessed the expertise of our participants to improve the *Texas Mathematics Teacher* by asking them lots of questions!

The facilitators were:

Cynthia L. Schneider, Ph.D., Independent Consultant

Mary Alice Hatchett, Independent Consultant

The 2015 participants were:

Arash Abnoussi from Midway, TX

Elizabeth Alaniz from Alamo, TX

Martha Godwin from Queen City, TX

Kristina Gill from Canyon, TX

Dittika Gupta from Wichita Falls, TX

If you would like to participate in the 2016 Writers Retreat, please complete the online application before October 1, 2015. The link may be found at *www.tctmonline.org* from the *Texas Mathematics Teacher* on the home page. All travel expenses are paid; all we need are your great ideas and time!

Cynthia L. Schneider, Ph.D.
• Independent K-12 Mathematics and Research Consultant
Austin, TX • <cschneider@utexas.edu>

Lives That Counted Scavenger Hunt

Fall 2014 Winner
Sandra Balis

Last Issue's Winner

Congratulations to **Sandra Balis** from Shelton School. Sandra won a $100 NCTM gift certificate. Her name was drawn from the correct submissions to the Tools of the Trade in the Fall/Winter 2014 *Texas Mathematics Teacher*.

Lives that Counted Scavenger Hunt

In this issue you need to name the mathmaticians described in the Lives That Counted Scavenger Hunt. The table below gives a discription as a clue ot each mathematican's identity. Each name may be found throughout this issue. Submit the person's name with the page number via email to Mary Alice Hatchett at <*mahat@earthlink.net*> by February 1, 2016. All correct entries will be entered into a drawing for a $100 NCTM gift certificate. The winner will be notified by February 15, 2016.

Clue	Answer	Page
Founder of computer science and cryptographer. He developed an electromechanical machine that was key to breaking the wartime Enigma code at Bletchley Park.		
A German physicist. He developed the general theory of relativity.		
A British mathematician specializing in number theory. He is most notable for proving Fermat's Last Theorem.		
A Greek mathematician who invented a hydraulic screw that raised water from a lower to a higher level.		
In his first arithmetic class at the age of eight he astonished his teacher by instantly solving a busy-work problem: to find the sum of the first hundred positive integers.		
Influential German female mathematician who revolutionized the fields of abstract algebra and theoretical physics.		
A Greek mathematician best known for his 13 volumes of mathematics texts called Elements.		
English mathematician, most famous for his law of gravitation.		
French female mathematician who battled against the social prejudices of the era. She is best known for her work in number theory.		
A Swiss mathematician who introduced much of the mathematical notation in use today, such as the notation f(x) to describe a function.		
A Greek mathematician best known for a theorem about triangles containing a right angle.		
A French mathematician who first proposed that each point in two dimensions can be described by two numbers on a plane.		

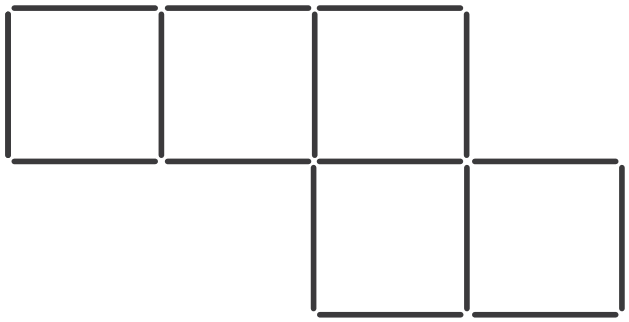
Puzzle Corner

Sticks #24 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

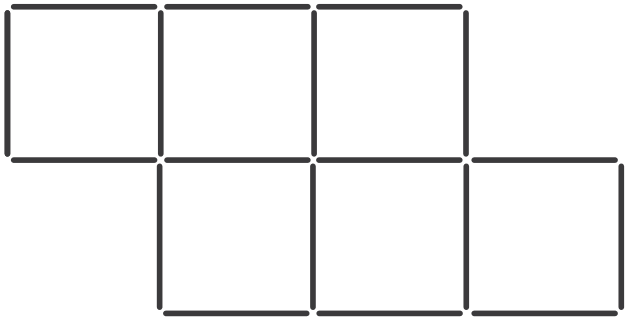
Arrange 16 craft sticks to form 5 squares as shown.



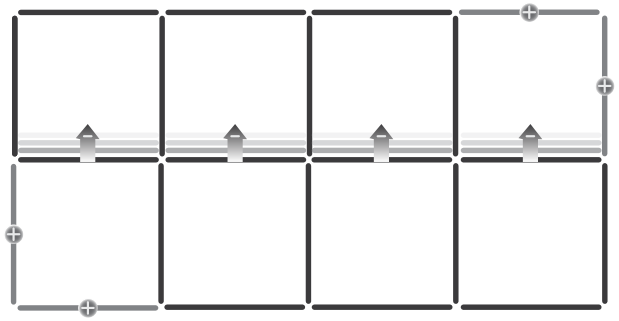
Puzzle: Now remove four sticks, making six squares.

Sticks #23 Answer

Arrange 18 craft sticks to form six squares, as previously shown.



Puzzle: Move 4 sticks, leaving three squares. Shown is a diagram of **a solution.**



arrows indicate a moved or removed stick
plus-sign on a stick indicates new position

Andrew Wiles
(1953-)

Quotes for Thought

"Sometimes, the most brilliant and intelligent minds do not shine in standardized tests because they do not have standardized minds."

Diane Ravitch
Professor at NYU
(1938–)

"If you help others, you will be helped, perhaps tomorrow, perhaps in one hundred years, but you will be helped. Nature must pay off the debt. It is a mathematical law and all life is mathematics."

G. I. Gurdjieff
teacher and writer
(1866–1877? – 1949)

"Mathematics is not a careful march down a well-cleared highway, but a journey into a strange wilderness, where the explorers often get lost. Rigour should be a signal to the historian that the maps have been made, and the real explorers have gone elsewhere."

W. S. Anglin
writer
(1866 – 1949)

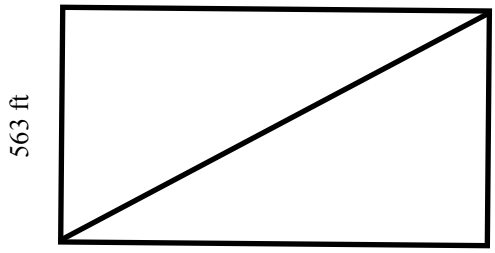
On The Cover

Find the Mathematics… in a monument!

Everything is BIGGER and BETTER in Texas – 'It Ain't Necessarily So' as the Gershwin song says. There is a sculpture that has been in progress since 1948 dedicated to the Native American Indian People in the Black Hills region of South Dakota. The monument depicts the Oglala Lakota Indian chief Crazy Horse who is credited with wiping out Custer's men at Little Big Horn. The sculptor's, Korezak Zilkowski, vision is of Crazy Horse on horseback throwing his arm out over the horse's head pointing in response to a Calvary man's question "Where are your lands now?" Crazy Horse replied, "My lands are where my dead lie buried." When completed it will probably be the world's largest sculpture, at a height of 563 feet and a length of 641 feet.

In thinking about the 'largeness' of this monument, here are a few things to consider:

1. How does the height of this monument compare to Niagara Falls?
2. Is it larger than the Pyramid of Giza?
3. Mount Rushmore, about 17 miles away, has the heads of 4 past US presidents, so is it 4 times the size of Crazy Horse?
4. If the height and length of this monument were the dimensions of a rectangle, what would be the length of the diagonal?



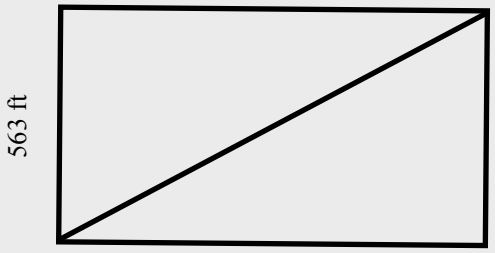
5. There are several structures in Houston, TX, that are taller than the Crazy Horse monument. Name at least two.
6. The ratio of Zilkowski's Crazy Horse model to the monument is about 1:300. What is the approximate height of the model to the nearest foot?

Mary Alice Hatchett • <mahat@earthlink.net>
Independent K-12 Mathematics Consultant • Georgetown, TX

On the Cover: Classroom Question Answers

In thinking about the 'largeness' of this monument, here are a few things to consider:

1. How does the height of this monument compare to Niagara Falls?
   [about 3 times the height]
2. Is it larger than the Pyramid of Giza?
   [Today because of erosion the Pyramid is about 456 ft tall. Originally the height was about 482 ft.]
3. Mount Rushmore, about 17 miles away, has the heads of 4 past US presidents, so is it 4 times the size of Crazy Horse?
   [no]
4. If the height and length of this monument were the dimensions of a rectangle, what would be the length of the diagonal? **[853 ft]**



5. There are several structures in Houston, TX, that are taller than the Crazy Horse monument. Name at least two.
   [JPMorgan Chase Tower at 1002 ft, Wells Fargo Plaza at 992 ft, Williams Tower at 901 ft, Bank of America Center at 780 ft, Heritage Plaza at 762 ft]
6. The ratio of Zilkowski's Crazy Horse model to the monument is about 1:300. What is the approximate height of the model to the nearest foot?
   [2 feet]

Voices from the Classroom

Graph That Data – A Survey Project for Grades 3-5

The data analysis TEKS for third through fifth grades all include a component of solving problems by "collecting, organizing, displaying, and interpreting data." The student expectations vary slightly from grade to grade, but this activity can be modified to deliver instruction and assist students in developing proficiency in the data analysis TEKS. After appropriate instruction, students are responsible for conducting a survey, organizing the data they collect, and displaying the data in a variety of graphical representations. This activity involves a high level of student engagement and certainly covers other TEKS due to the variety of skills required to complete it. I used this activity for a number of years with my students, and they really enjoyed the amount of interaction with others that it involved and having the opportunity to do "fun math."

Instruction:

Examine a variety of graphs appropriate to your grade level with students. Lead a discussion with students that data collection is used to build a graph. Demonstrate methods for organizing data collection such as using a spreadsheet or an organized list. Talk about scaled intervals in building a graph.

Activity:

(1) Students randomly draw a survey question from a teacher prepared list. I prefer to have students draw a topic at random to expedite the process of getting them started on the project. Students tend to have difficulty in selecting a topic, so the random selection of their question alleviates this excuse for procrastination. I also include 4 answers from which those surveyed choose their response. I have included a list of survey questions, but students could come up with their own survey question and possible answers.

(2) Students survey 100 people and record their responses on the spreadsheet I provide to them. Remember that students need to be taught the method to organize the data.

(3) On a piece of poster board students provide a visual presentation or display of the data they have collected using 3 different graphical representations. The graphical representations should be grade appropriate as listed.

Prior Knowledge:

Students need a working knowledge of graphs appropriate for their grade level.

Vocabulary:

3rd grade – frequency table, dot plot, pictograph, bar graph, scaled intervals

4th grade – frequency table, dot plot, stem-and-leaf plot, scaled intervals

5th grade – bar graph, frequency table, dot plot, stem-and-leaf plot, scatterplot, and scaled intervals

Differentiation:

(1) This activity can easily be modified for students by reducing the number of people they survey or reducing the number of graphical representations to 1 or 2.

(2) Students can work with a partner to complete the activity.

(3) For students who are more capable than average, the survey question can be student written, or they can develop their own means of organizing the data

Martha Godwin • President, TCTM
Queen City, TX • <marthagodwin78@aol.com>

Alan Turing
(1912-1954)

Data Analysis

Step 1

Select a survey question. Each student will draw a topic at random from this list:

1. Which is your favorite color from these choices: red, blue, green, or purple?
2. What is your favorite pizza from these choices: cheese, pepperoni, hamburger, or Canadian bacon?
3. Which is your favorite sport: football, basketball, baseball, or volleyball?
4. Which is your favorite class: reading, math, science, or social studies?
5. Which is your favorite type music: rock, country, rap, or classical?
6. Which type books do you most like to read: mystery, science fiction, biographies, or information?
7. Which is your favorite season: winter, spring, summer, or fall?
8. Which type movies do you most like to watch: comedy, romance, action, or science fiction?

Step 2

Survey 100 people and record their names and responses in the table provided.

Step 3

Using the sheet of poster board provided, display the data you have collected on 3 different graphic organizers. Choose from this list.

(1) bar graph
(2) frequency table
(3) dot plot
(4) pictograph
(5) stem-and-leaf plot
(6) scatterplot

Emmy Noether
(1882 – 1935)

Question # ___ _____

_____

#	Name	*Ans 1*	*Ans 2*	*Ans 3*	*Ans 4*
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
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12					
13					
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29					
30					
pg	page ____ of ____				

Totals	Ans 1	Ans 2	Ans 3	Ans 4
	_____	_____	_____	_____

Application Information

2016-17 Mathematics Preservice Teacher Scholarship

There are ten $2000 scholarships available for 2016-17. Any student attending a Texas college or university - public or private - and who plans on student teaching during the 2016-17 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. Look for the scholarship application online at *<www.tctmonline.org>*. The application deadline is May 1, 2016. Winners will be announced in July 2016.

2016 TCTM Grant

This grant is for K-12 educators, university faculty and NCTM affiliate groups in Texas. Please note, pre-service teachers are not included as they can apply for the Mathematics Preservice Teacher Scholarship. The grant can be awarded to an individual, a group of teachers or to another NCTM or NCSM affiliate organization, if they are in Texas. Grant requests up to $1,200 will be accepted. Uses include (1) improving mathematics classroom(s), or (2) helping your school achieve its goals related to mathematics, or (3) promoting mathematics teaching and learning, or (4) improving your ability to teach mathematics.

The online application may be found at *<www.tctmonline.org>*. The application deadline is November 30, 2015. Awardees will be notified by January 31, 2016.

2016 Texas Mathematics Teacher's Writers Retreat

If you would like to participate in the 2016 Writers Retreat, please complete the online application before October 1, 2015. The link may be found at *www.tctmonline.org* from the Texas Mathematics Teacher on the home page. All travel expenses are paid; all we need are your great ideas and time!

NCTM Membership

What's an easy way to support TCTM?

Join NCTM or renew your NCTM membership!

Sign up for your NCTM membership and use the link on the web form to indicate TCTM as the affiliate you wish to receive a rebate! Go to *<www.nctm.org>*.

TCTM will receive $5.00 if you are joining NCTM as a new member, and $3.00 if you are renewing. Now you can sign up directly with NCTM and give back to your state affiliate. However, you may only choose one state affiliate for the rebate (it will not be split).

Please remember, you cannot join your local affiliates from the NCTM website. You must join the local affiliates directly by the process they have established. You may join TCTM by either attending the CAMT conference as a paid participant, or by using our membership form found online at *<www.tctmonline.org>*.

TCTM Membership

Join TCTM or renew your membership!

Please join TCTM each year! Your membership includes this journal as well as updates on state and national opportunities such as grants, competitions, or professional development. You may join TCTM by either attending the CAMT conference as a paid participant, or by using our membership form found online at *<www.tctmonline.org>*. If you are a paid participant at CAMT your TCTM membership is automatic for the school year following CAMT. Remember to renew your membership if you do not attend CAMT or are not a paid participant. Our current membership dues are only $13.00 per year. If you are a new or returning member, please find our membership form online at *<www.tctmonline.org>*. Just fill out the form and mail your check to our current treasurer. Sorry, we are not able to process electronic payments, but you can join or renew for multiple years. You may also donate to our scholarship fund at any time.

Presidential Awards for Excellence in Mathematics and Science Teaching

The **Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST)** are the nation's highest honors for teachers of mathematics and science. Awardees serve as models for their colleagues, inspiration to their communities, and leaders in the improvement of mathematics and science education. Nominations for mathematics and science teachers of grades k-6 will open in Fall of 2015. Please see <*www.paemst.org*>.

A state panel of master teachers, specialists, and administrators review the applications and choose the outstanding mathematics teachers for the National Science Foundation to consider for state finalist status. After an initial selection process at the state level, a national panel of distinguished scientists, mathematicians, and educators recommends a finalist to receive the national award. If chosen as a national winner, the state finalist will receive $10,000 and an all expense paid trip for two to Washington D.C. for ceremonies that include recognition from the president of the United States at the Capitol.

In the fall, outstanding certified mathematics and science teachers in grades k-6, with five years or more of teaching experience, will be eligible to apply. If you would like to nominate an outstanding mathematics or science teacher, nomination forms and applications will be available at the website above in the fall.

PAEMST 2013 Mathematics Winner: Jessica Caviness, Coppell, TX

Jessica Caviness is completing her 11th year in Coppell, Texas teaching ninth graders Geometry and Algebra II at Coppell High School. Jessica's 14 years in the classroom include experience with sixth through eighth grade mathematics, as well as Algebra I.

Jessica has been recognized for creating innovative and transformative learning experiences for her students. Her classroom is filled with engaged learners, creating evidence of understanding to be shared beyond the walls of the classroom. Jessica has excelled in designing technology-rich learning experiences with the Coppell Independent School District's 1:1 iPad initiative in mind. Her students enjoy using Skype to guide elementary learners to understand geometric concepts, as well as connect with authentic audiences to make real-world applications of their classroom learning.

Jessica has presented sessions on innovative learning design at several local, state and national conferences. Jessica has also been featured in an article titled "How Twitter Can Be Used as a Powerful Educational Tool," as well as a blog post titled "Bringing Geometry to Life with Twitter" in the November Learning newsletter and blog.

Jessica has a B.S. in interdisciplinary studies from Stephen F. Austin State University, and is certified in elementary and secondary mathematics, grades K-12.

Remember to Renew Your TCTM Membership!!

If you did not attend CAMT 2015, this may be your last issue of the *Texas Mathematics Teacher*. Download the membership form and send in your $13 to keep your subscription and membership current.

Sophie Germain (1776 –1831)

CAMT 2016

CAMT 2016: Go for the Gold
Henry B. Gonzalez Convention Center

June 29 – July 1, 2016
San Antonio, TX

The Conference for the Advancement of Mathematics Teaching (CAMT) 2016 will be held June 29 – July 1, 2016, at the Henry B. Gonzalez Convention Center in San Antonio, Texas. Take advantage of early-bird registration discounts before April 15.

For more details, visit the CAMT website at *<www.camtonline.org>*.

Archimedes
(c.287 – c. 212 BC)

CAMT 2016 Volunteers

Dear Members of TCTM,
It's time to VOLUNTEER!

We believe that there is an opportunity for everyone to find their niche in helping CAMT to be a success for everyone involved – here's how you can join in on the efforts (we would love to have over 250 volunteers ready to go!). We are looking for fellow mathematics educators to assist us with supporting participants in areas such as the following: Registration, Exhibits, or Speaker Check-In. Come work "behind the scenes." We need you! Please e-mail your name and contact information (be sure to include contact information for the summer) to Kathleen Hart-Abel, along with which of the following dates you are available to volunteer. Kathleen will respond via e-mail or phone with a specific scheduled time and location.

Thank you for making every CAMT a wonderful experience!

2016 Volunteer Information

I am willing to volunteer on June	28th PM	29th AM	29th PM	30th AM	30th PM	1st AM	1st PM

Name: First | Last

Address:

City | State | Zip Code

Contact: ( ) Cell Phone | Email Address

( ) Home Phone | District or Professional Affiliation | ESC

Please submit your form to Kathleen Hart-Abel,

by mail: **Kathleen Hart-Abel**
10117 Brookshore Ln
Pearland, TX 77584

or by email:
<Kathleen.hart@live.com>

Factoids

TEA 2014 Snapshot Data

District Size	50,000 and Over	25,000 to 49,999	10,000 to 24,999	5,000 to 9,999	3,000 to 4,999	1,600 to 2,999	1,000 to 1,599	500 to 999	Under 500
Count of Districts	18	31	58	70	91	138	145	247	429
Total Number of Schools	1,852	1,403	1,313	766	629	650	547	716	698
Students									
Total Students	1,478,689	1,132,588	910,902	491,904	352,187	299,546	181,894	176,732	111,438
% African American	16 2	11 9	10 7	15 4	8 4	10 1	7 1	11 3	9 4
% Hispanic	56 8	57 2	55 2	42 6	44	43 7	40	35 5	35 8
% White	19 1	23 7	28 6	37 7	43 5	42 7	49 2	49 6	51 5
% American Indian	0 3	0 4	0 4	0 5	0 4	0 5	0 5	0 5	0 4
% Asian	5 8	4 8	3 1	1 7	1 5	1 2	1 3	0 8	1 1
% Economically Disadvantaged	63 4	59 1	59 3	56 9	58 2	61 6	58 9	58 2	59 4
% English Language Learners (ELL)	23 1	20 1	16 7	12 9	11 7	12	9 3	7 6	7 3
% Special Education	8 3	8 6	8 5	8 3	8 4	8 3	8 6	9	9 4
Staff									
Total Staff FTE	179,684 10	142,385 90	114,987 20	62,260 80	45,727 40	40,947 70	25,966 10	26,443 40	18,138 90
Total Teacher FTE	91,729 90	72,395 10	57,357 40	31,236 70	23,587 40	20,710 80	13,388 00	14,200 30	9,904 90
Average Central Administrative Salary	103,759	95,588	96,741	99,742	96,289	92,345	88,401	85,129	79,198
Average School Administrative Salary	76,605	75,478	73,279	71,485	68,160	68,337	67,245	66,376	63,728
Average Professional Support Staff Salary	62,096	59,611	58,145	57,211	54,442	52,498	52,536	49,668	45,526
Average Teacher Salary	52,400	51,312	50,366	48,820	46,867	45,586	44,662	43,711	42,311
% Minority	54 3	54	48 6	37 8	30 8	32 4	28 7	26	25 8
Number of Students Per Total Staff	8 2	8	7 9	7 9	7 7	7 3	7	6 7	6 1
Number of Students Per Teacher	16 1	15 6	15 9	15 7	14 9	14 5	13 6	12 4	11 3
Teachers									
% With 5 or Fewer Years of Experience	33 7	32 4	33 1	33 7	35 7	36 3	31 8	34 5	35 9
Average Years of Experience	11	11	11 2	11 2	11 3	11 5	12 3	12 1	11 6
% With Advanced Degrees	28 7	25 2	23 5	23 2	19 4	16 8	16 6	16 4	15 7
Teacher Turnover Rate	15 1	13 4	15 1	17 4	18 3	20 5	19 3	22 4	23 5
% African American	17	7 8	6 2	10 4	4	5 3	4 1	7	5 7
% Hispanic	25 5	35 4	31 3	17 1	17 1	16 7	15 2	10	11 2
% White	53 5	53 8	60 2	69 9	76 6	76 2	78 9	81 5	81 2
% Other	4	3	2 3	2 6	2 3	1 9	1 9	1 5	2
Actual Expenditures									
Total Expenditures (2012-13)	15,337,058,215	11,393,311,815	9,327,501,889	4,979,194,631	3,626,176,585	3,139,704,518	2,014,566,073	2,030,722,109	1,405,851,121
Total Operating Expenditures (2012-13)	11,787,552,840	9,009,926,592	7,382,008,042	3,928,766,095	2,883,045,366	2,529,325,398	1,617,847,326	1,697,314,684	1,182,856,215
Total Operating Expenditures Per Pupil	8,069	8,070	8,268	8,191	8,326	8,722	9,053	9,844	10,769
% Instructional	59 2	58 8	56 6	55 8	54 9	54 3	54 3	53 9	53 1
% Central Administrative	5	5	6 1	7	7 1	7 5	7 9	9 7	12
% School Leadership	6	5 8	5 6	5 6	5 8	5 8	5 8	5 9	6 2
% Plant Services	10 5	10 2	11 5	11 5	12 1	12 2	12 5	12 1	12 3
% Other Operating	19 3	20 1	20 2	20 1	20 1	20 2	19 6	18 4	16 4
Total Instructional Expenditures	6,982,563,941	5,298,942,275	4,175,127,239	2,193,075,397	1,581,928,716	1,373,141,232	877,713,015	914,347,699	628,419,839
Total Instructional Expenditures Per Pupil	4,780	4,746	4,676	4,572	4,569	4,735	4,911	5,303	5,721

Source: Elements from the Texas Education Agency 2014 Snapshot Data, downloaded July 25, 2015 from http://ritter.tea.state.tx.us/perfreport/snapshot/2014/distsize html

TEA Talks

The Texas Education Agency (TEA) has several webpages important for mathematics educators.

Curriculum

To find out more about the Texas Essential Knowledge and Skills (TEKS) and resources to support their implementation, see the TEA website at *<www.tea.state.tx.us>*. On the left, click on Curriculum and scroll down to the quick links (different from the home page quick links) to Curriculum Division. On this page, scroll down to the Curriculum Newsletters to download a pdf of the most current information about the standards and professional development or click on the link to Mathematics for more subject-specific information. For additional information, contact: James Slack, Statewide Mathematics Coordinator at (512)463-9581 or *<james.slack@tea.state.tx.us>*.

Assessment

To find out more about the State of Texas Assessments of Academic Readiness (STAAR) and changes resulting from the new mathematics TEKS, see *<www.tea.state.tx.us>*. On the left, click on Testing and Accountability and scroll down to the quick links to STAAR. Information about standard setting, timelines, blueprints and more can be found on this page. For additional information, contact: Student Assessment Division at (512) 463-9536 or *<student.assessment@tea.state.tx.us>*.

Euclid (mid-4th century -Mid 3rd century BC)

Apply now for a MET Grant, Scholarship, or Award!

NCTM's Mathematics Education Trust (MET) channels the generosity of contributors through the creation and funding of grants, awards, honors, and other projects that support the improvement of mathematics teaching and learning.

MET provides funds to support classroom teachers in the areas of improving classroom practices and increasing mathematical knowledge. MET also sponsors activities for prospective teachers and NCTM Affiliates, as well as recognizing the lifetime achievement of leaders of mathematics education. Grant, scholarship, and award funding ranges from $1,500 to $3,000 and can be used for conferences, workshops, seminars; research and in-service training in mathematics coursework; or professional development activities. **The deadline is May 6, 2016**.

If you are a teacher, prospective teacher, or school administrator and would like more information about MET grants, scholarships, and awards, please visit their website,

< www.nctm.org/Affiliates/Resources/MET-Grants-to-Affiliates/>

or e-mail them at *<exec@nctm.org>*.

2016 Texas STEM Conference

The Texas STEM Coalition is proud to announce plans for the 2016 Texas STEM Conference in San Antonio on January 21-23 at the Omni San Antonio Hotel at the Colonnade. Because of previous success with the conference, we are growing to a bigger facility. We will be able to accommodate about 700 of the best STEM educators who want to share and learn best practices related to STEM education.

A press release that contains links to the conference, how to submit a session proposal by September 13, and hotel reservation information is found at *<http://www.txstem.org/images/files/PressRelease-2015-July22-TxSTEMconference.pdf>*.

Affiliate Leaders Conference 2015

The NCTM Affiliate Leaders Conference is designed for teams of current and potential leaders of all National Council of Teachers of Mathematics (NCTM) Affiliates. In July 2015, TCTM sent Martha Godwin, President; Philicia Upchurch, NCTM Representative; and Sherita Wilson-Rodgers, incoming Southeast Regional Director, to the conference in Phoenix, AZ. At the conference participants learn about NCTM and network with other affiliate leaders about resources and processes to accomplish the work of their local councils.

Pictured from left to right: Philicia Upchurch, Martha Godwin, Diane Briars, current NCTM President, and Sherita Wilson-Rodgers.

Recommended Reading

NCTM promotes the collaboration of reading and mathematics and suggest that selecting adolescent's trade books involving mathematics can help teachers develop their problem-posing skills by using that literature in their mathematics instruction.

Missing Math: A Number Mystery
By Loreen Leedy ISBN: 1477810927
Publisher: Two Lions

Missing Math: A Number Mystery is a colorful informational picture book that causes students to think about what would happen if all the numbers disappeared …. suddenly no one could count, add, subtract, multiply, tell time, use money, keep score, make phone calls, or take part in many everyday activities. It's an entertaining way for young kids to see how important numbers and math are.

Other (math) books by Loreen Leedy

- *Fraction Action*
- *Mission Addition*
- *Seeing SYMMETRY*
- *Measuring Penny*
- *2 X 2 = BOO! A Set of Spooky Multiplication Stories*

Arithme-Tickle: An Even Number of Odd Riddle-Rhymes
By J. Patrick Lewis ISBN: 0152058486
Publisher: HMH Books for Young Readers

These 18 kid-friendly challenging riddles are a wonderful way to spark students' interest in math! They will tickle your students' funny bones while allowing them to practice their math skills. These riddles could be a great way to begin a math lesson by letting different students read each line of the poem as it comes together as one riddle. Follow with a class discussion about what they think the answer is and why; then presenting the correct solution with a demonstration of how they solved it.

Other math riddle books:

- *The Grapes of Math* by Greg Tang
- *Math for All Seasons: Mind Stretching Math Riddles* by Greg Tang
- *Marvelous Math: a book of Poems* by Lee Bennett Hopkins

Mary Alice Hatchett • <mahat@earthlink.net>
Independent K-12 Mathematics Consultant • Georgetown, TX

Carl F. Gauss
(1777 –1855)

Voices from the Classroom

Book Study Reflections

First Steps

In today's fast paced world, the need for new and innovative ways to teach are crucial to student success. Upon recognizing this, we realized our teachers would benefit from learning how to implement small changes in how mathematics lessons were being presented. Conducting a book study on current trends and best practices seemed like a perfect place to start. Guided reading has been the buzz for many years now, but what about guided math? There was a book study being conducted at the district level utilizing *Guided Math in Action* by Nicki Newton. We knew we had the perfect choice for our book study! After surveying the staff to see how many teachers would be interested in participating in the book study, we decided to move forward because of the number of teachers interested. As the presenters, we determined the dates and times of the book study and what would be expected of the teachers. Once these details were set, we met with the teachers that showed an interest and they decided if they could make the commitment. We ended up having nine participants, which thrilled us. Our campus serves students in pre-kindergarten through fourth grade. Our participants represented kindergarten through fourth grade. Some grade levels had more than one person from their grade level attending the book study. The next step of preparation was to order copies of the book. We then got to work collaborating on the presentations that would take place during each session. We met once a month and covered one chapter during each meeting. Our presentation consisted of district resources that we modified to fit the needs of our campus. Once the planning was completed we were ready to begin!

Brainstorming/reflection activities incorporated into the book study.

Campus Impact

Our goal from the beginning was to support teachers by encouraging them to explore varying approaches to differentiated mathematics instruction. The laid back atmosphere of the book study allowed teachers to feel comfortable sharing their struggles, ideas, and suggestions. These discussions led to what we like to call, "aha moments." Teachers don't often get the opportunity to have these discussions and when they do it is typically in the form of a vertical alignment meeting where they don't feel as comfortable sharing. As mentioned earlier, several grade levels were represented during this book study. This added to the quality of our discussions. The teachers were open with each other and shared what they would like to see the grade level below them do in order to make the students as prepared as possible for the next grade level. We also began to see and hear what the teachers were going back and implementing as a result of the book study. The teachers were able to create authentic assessments, methods of grouping, and visual representations throughout their room to aide in the implementation of guided math instruction. The impact that this has had on our students was also evident. As a whole, the teachers that participated in the book study began to see increased excitement in their students when it came to their mathematics block. One teacher stated, "When our schedule had to be rearranged due to a program, it resulted in having to cut out math stations that day. The kids were so disappointed." Students being excited about mathematics was music to our ears. We understand that this endeavor will be an ongoing process and we are confident that the impact over time will lead to significant gains in student performance and teacher proficiency.

Advice from the Authors

As educators, reflection is key to achieving excellence within our profession. Upon completing the book study, we took time to think about what we will do differently next time. As presenters, there are four main things we would do differently. First, offering various incentives to our teachers to gain participation from every grade level is something that we will include next year. We all know teachers love

jean passes! For those who may be unfamiliar with jean passes, this is where the teachers get a pass to wear jeans to work one day instead of their regular professional attire. It doesn't cost a thing and the teachers are always excited to get a jean pass. Second, in addition to the PowerPoint we used, we would make a detailed anchor chart as we present each chapter. If you are not sure what an anchor chart is, let me explain. An anchor chart is often used as an interactive tool when a concept is being taught. As the lesson (or in our case book study) is being presented, the teacher and students come up with what to put on the anchor chart that will help them process the information. After the lesson, the anchor chart is displayed in the classroom and can be referred to for reinforcement. In our district, we use them so often in our classrooms that it seemed perfect to incorporate it into the book study. We utilized anchor charts in some of our sessions (as pictured above) and felt that the level of interaction and discussion increased when we did this. Adding this into each session will just enhance the quality of what is learned. Third, including more make-and-take opportunities is something we will strive for in the future. We realize that time is a critical issue and that there isn't always enough time to collaboratively create resources for instruction during the school day. Therefore, if we allow time during the book study for the participants to make resources that can be used during their guided math time, the more successful they will be. Last, as we looked at the culmination of notes and activities that we presented, we realized we should have kept better records. Next time, we will collaborate after each presentation to write down our thoughts and ideas to help us to continue to improve. Overall, this was a rewarding experience for us as presenters, for our teachers, and for our students.

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Isaac Newton
(1643–1727)

2015 TCTM Grant Recipients

Ten TCTM Grants were awarded this year by TCTM. We would like to extend our congratulations to each of the following recipients. All recipients created a proposal for how they would use funds awarded to them. Uses include (1) improving mathematics classroom(s), or (2) helping your school achieve its goals related to mathematics, or (3) promoting mathematics teaching and learning, or (4) improving your ability to teach mathematics. For more information on the process, requirements, and deadlines for the TCTM Grant, please visit our TCTM Grant Application page online at *<www.tctmonline.org/grant_apply.html>*

Pragati Bannerjee Corpus Christi	**Barba Patton** Victoria
Tammy DeRick Pasadena	**Abby Turner** Pflugerville
Jeffry Fox Corpus Christi	**KaSai Un** Dallas
Yolanda Guerrero Corpus Christi	**James Valles, Jr.** Prairie View
Ashley Johnson Austin	

2015-16 Mathematics Preservice Teacher Scholarship Awardees

Ten Texas students were awarded the $2000 TCTM Mathematics Preservice Teacher Scholarship for 2015-16. We would like to extend our congratulations to each of the following recipients. Each scholarship awardee attends a Texas college or university - public or private - and works as a student teacher in order to pursue teacher certification at the elementary, middle or secondary level with a specialization or teaching field in mathematics.

 **Amanda Blair** Texas A&M University – Corpus Christie	 **April Iocco** Univeristy of Houston – Clear Lake
 **Lyndsie Dunson** West Texas A&M University	 **Evie Morrow** West Texas A&M University
 **Brittney Fluty** Sam Houston State University	 **Emily Walker** West Texas A&M University
 **Sabrina Hight** University of Texas – Tyler	 **Sarah Westphal** Texas Christian University
 **Lindsay Hixon** Sam Houston State University	 **Nicole Whitehead** Baylor University

Leonhard Euler
(1707 –1783)

TCTM Leader Spotlight

Each year since 1995, TCTM has accepted nominations for two awards for leaders in our professional community. The TCTM Leadership Award is presented to a TCTM member who is nominated by a TCTM affiliate. The second award, the E. Glenadine Gibb Achievement Award, is presented to someone nominated by a TCTM member. The following individuals have been honored and we wish to acknowledge their former and ongoing contributions this year in the leader spotlight. **If you wish to nominate someone for 2016, please download the forms from our website. Please submit your nomination by Dec. 31, 2015.**

Our prior awardees are:

Year	Leadership(local/state)	Gibb (state/national)
1995	Mary Alice Hatchett	Iris Carl
1996	Betty Forte	Cathy Seeley
1997	Diane McGowan	Pam Chandler
1998	----	----
1999	Linda Shaub	Eva Gates
2000	Lloy Lizcano	Bill Hopkins
2001	Susan Hull	Pam Alexander
2002	Janie Schielack	Judy Kelley
2003	Bonnie McNemar	Dinah Chancellor
2004	Dixie Ross	Jacqueline Weilmuenster
2005	Barbara "Basia" Hall	Barrie Madison
2006	Nancy Trapp	Lois Gordon Moseley
2007	Kathy Hale	Cynthia L. Schneider
2008	Jim Wohlgeheagen	Juanita Copley
2009	Jane Silvey	Jo Ann Wheeler
2010	Elaine Young	Paula Steffen Moeller
2011	Beverly Burg Anderson	Jennie M. Bennett
2012	Paul Gray, Jr.	Linda Gann
2013	Vodene Schultz	Anne Papakonstantinou
2014	Caren Sorrells	Noemi Rodriguez-Lopez
2015	Jennifer Hylemon	Bea Luchin

René Descartes
(1596 – 1650)

2015 TCTM Leadership Award

Jennifer Hylemon

This year, TCTM is pleased to honor **Jennifer Hylemon** for her leadership across the state of Texas.

Jennifer is the K-12 director of mathematics in Grapevine-Colleyville ISD after serving as the PK-12 mathematics coordinator in Irving ISD. Jennifer serves as a leader at the local level through McMath (North Texas math supervisors and lead teachers group) and serves as a leader at the state level as a member of the CAMT Board, where she focuses her efforts on integrating 21st century technology and learning needs into all facets of one of the largest mathematics teachers' conferences in North America..

2015 E. Glenadine Gibb Achievement Award

Bea Luchin

TCTM is pleased to honor **Bea Luchin** for her leadership at both the state and national levels.

Bea has an extensive background both as a classroom teacher, professional developer, textbook author, and leader in mathematics at the local, state, and national levels. In addition to classroom teaching experience in Houston ISD, Bea is also a former member of the NCTM Board of Directors and served as the CAMT Program Chair in 2009. She facilitates numerous professional development sessions across the nation, helping teachers both in Texas and many other states sharpen their expertise. Bea is a featured speaker with the Bureau of Education Research and was a keynote speaker for CAMT 2015.

Time to Huddle Up…. Coaching Your Mathematics Teachers to a Win with Students!

In a class where I was observing and mentoring, I had seen Samantha struggle with using substitution to solve a system of equations. She was a gifted math student, but for some reason, she was having trouble with how to substitute one equation into another and solve for 'x' correctly. She seemed to be at a point of impasse, though all of her friends understood the concept of substitution already.

On this particular day, her head was low. I could see the frustration on her face. Her hands were flat on the desk, almost a symbol of her 'giving up.' However, on this particular day, the teacher I was observing retaught the concept in a different way… and finally, Samantha got it. I heard a squeal come from the back of the room, then laughter from a group of her friends. They were all high-fiving each other, and Samantha began jumping up and down.

That excitement is what I love about teaching; that is what I look for when I walk into an Algebra class or any mathematics class I have coached teachers in. I love to see students 'get it' as teachers work with them…seeing the light bulb go on …it is like electricity. Coaching teachers has changed me as a mathematics specialist and has shown me that true collaboration with teachers, at any grade level, can create a win-win situation for all concerned in the classroom, thus having an impact on student achievement.

Reasoning – Its Importance

It is at that point, once a student has come to an understanding of the concept that the student is able to move forward in the journey of mathematical understanding. Samantha was there. She had hit a roadblock. She couldn't move forward under her own power, but once her teacher enabled her to rework the concept of substitution through reasoning skills, she could move forward.

That is true for all math students. If a math student is not progressing forward, we, as mathematics teachers, have to figure out where they are not able to grasp understanding of the concept at hand. That sounds easy, but reasoning is a hard concept to teach, as well as to understand. It is difficult for reasoning to be 'seen' in the classroom. Reasoning involves being able to solve multiple-problem types, including missing values, numerical comparison, the effect of different variables on the performance of a situation, and qualitative prediction.

Instruction should start with familiar contexts, teaching multiple strategies, and using more intuitive strategies in the beginning. Finally, coaching teachers in the area of reasoning should emphasize learning concepts over learning procedures. Students differ in abilities within each class, which makes the job of coaching reasoning techniques even harder. As a teacher I may have understood how to communicate with my students, but as a mathematics coach…well, it was much harder to explain to teachers how to do it.

The Role of the Mathematics Coach

So, what does it take to help? I began to think about coaching and how impactful that role is in developing teachers on a campus. Research shows that the role of a coach is a specialized one, the intent being that school-based mathematics specialists or coaches support the improvement of mathematics teaching and learning by targeting the teachers' content and pedagogical knowledge (Neufeld & Roper, 2003; Poglinco, et al., 2003, National Research Council 2001). Feger, Woleck, and Hickman (2004) found that effective coaching: (a) encourages collaborative, reflective practice; (b) promotes positive cultural change; (c) focuses on content and encourages the use of data analysis to inform practice; (d) promotes the implementation of learning and reciprocal accountability; and (e) supports collective, interconnected leadership across a school.

The mathematics coach works alongside the team of teachers using their skills (a deep understanding of mathematics and of how students learn, as well as a refinement of pedagogical technique) to increase the school's instructional capacity (Campbell & Malkus, 2011, & Neufeld & Roper, 2003). Additionally, coaches will address issues with curriculum, instruction,

and assessment, all the while serving alongside the mathematics teachers so that the environment is both collaborative and synergistic. The ultimate goal of coaching is the advancement of school-wide growth and change, as well as student learning and achievement (Campbell & White, 1997; Marzano, Walters, & McNulty, 2005; York-Barr & Duke, 2004).

Of course, these are the job-description elements of content coaches, but the essence of coaching is having the belief in a colleague and sharing your skills to enhance that colleague's practice. Here are three areas in which you can coach teachers and see success on your team.

Observation and Analyzing Student Work

Observation is an essential element of coaching. Observations were initially conceived as tools for evaluation; such protocols are now seen as key levers for the improvement of teaching (Hill & Grossman, 2013).

In the role of observer, you can learn much that will help your teachers. You can (a) make suggestions to improve a teacher's classroom practice by deepening their knowledge of best practices, (b) validate alternative teaching strategies, and (c) address instructional deficiencies (Suber, Garrison, & Martin, 2001; Olson & Barrett, 2004). As an observer, you need to make notes, do the lesson, record it if the teacher is willing, and write down what the students are doing. This provides rich data for the teacher. When you get together with the teacher, the two of you can discuss the lesson in detail.

Then turn to student work. This is the analysis or reflection part of working with teachers. Questions center around: (1) was the lesson student-centered? (2) What were the strengths and weaknesses of the lesson? (3) What did the students master? (4) What needs re-teaching?

As you and the teacher reflect on student work, the following questions can guide the conversation:

1. What alternative instructional strategies can be used to increase learning?
2. What instructional strategies can be used to aid in the re-teaching of the skills not mastered in the lesson?
3. What samples of student work provide an example of understanding? What samples provide an example of lack of understanding?
4. What content in the sample work proves understanding? What content in the sample work proves lack of understanding?
5. If you have Pre-AP or even regular classes, what papers provide exceptional understanding, and what does that look like?
6. What background knowledge is lacking in papers where students did not show mastery of concepts from the lesson?
7. What concepts or aspects of the lesson did the students fail to show understanding of?

Executing the Objective

Working with teachers to plan and execute lessons can be a challenge, but helping them understand what they need to focus on in their lessons is really rewarding. In doing this, I have found that many teachers forget to show their students the process of determining if they are successful at the end of the lesson, through such strategies as exit tickets, self-reflection, homework checks, verbal questioning etc. Students should be able to achieve the objective successfully at the end of the lesson and when the assessment is given. If not, then the students should be able, during the reflection phase, to determine what they need to do to move forward with the content.

If the student determines what he or she needs to move forward, then the teacher will analyze student work to determine intervention and remediation strategies prior to unit testing (Paek, 2008). As student work is analyzed, a lot of information can be found by looking at the errors and the pattern of errors of student work. It could be a gap in knowledge, student misunderstanding, teacher miscommunication, lack of student effort, or even difficulty in handling an assignment.

Invest Yourself: It is Worth It!

As a math coach, it was my strategy to give the teacher a week to implement whatever strategies we decided upon; however, I was in their classes every day. That was the main focus of my job. I met

with my teachers' each week for thirty minutes to follow up with them and help them move forward in their teaching strategies. At each meeting we would discuss what was working and what was not working and tweak our plans accordingly.

The teacher needs to remember that kids change as the year goes on. Every day has a new set of circumstances. What works with one group of students may not work with the next; it is forever changing and that is the beauty of pedagogy. As an educator and coach I am constantly locating the gaps in data and modeling strategies that have worked with my kids in order to help other teachers, but with the trepidation that it may not work and that is okay.

Conclusion

Remember Samantha? Well, she moved forward. Two weeks later the class was studying how to graph quadratics. A student named Will was having a hard time understanding how to find the vertex, and Sam jumped up, went to board, and began writing something. In her own words, she explained the process of finding the vertex and then transforming it appropriately. The entire class in unison went "Ahhhh" as she spoke. Samantha had a way of making the hard seem easy with her classmates. At times she struggled with concepts. But when she got it, she got it. After she finished speaking, Will stood up and went to the board and graphed the next question, without error.

When coaching, if something isn't working, we change it immediately. When something is working, we still look to see where we can improve on our pedagogy with our students in order to refine our craft. In both cases, we reflect and evaluate our teaching and communication with our students in order to become more effective and helpful to the students that we are entrusted with. That is the part of the implementation process of curriculum that I find intriguing.

What works with one group of students may not work with the next…it is forever changing and that is the beauty of pedagogy. As an educator and coach, I am constantly locating the gaps in data and modeling strategies that have worked with my kids in order to help other teachers, but with the trepidation that it may not work and that is okay.

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Legislative Update and Advocacy

It has been a busy spring/summer in Austin. Both the Texas Legislature and State Board of Education have made decisions that will affect Texas mathematics teachers in their classrooms, beginning in the 2015-16 school year.

Actions from the Texas Legislature

The 84th Texas Legislature adjourned on June 1, 2015, and passed several bills relating to mathematics education. Of the most direct impact to Texas mathematics classrooms, House Bill 743, authored by Rep. Dan Huberty (R-Kingwood), addresses changes to both STAAR and potentially the mathematics TEKS. HB743 requires TEA to determine, through a third-party study, that each STAAR test will be both valid and reliable in terms of making sure that it measures what students know about the TEKS for that grade and subject and that it measures student achievement consistently. HB743 also places time limits on any one STAAR test: for grades 3-5, 85% of students should be able to complete the test within 2 hours, and for grades 6-8, 85% of students should be able to complete the test within 3 hours.

In terms of curriculum, HB 743 also requires TEA to study the TEKS of the foundation curriculum, including mathematics, to evaluate both the number and scope of the TEKS and whether the TEKS for a particular grade level or course should be limited. TEA will deliver a report from the study to the State Board of Education (SBOE) by March 2016. The SBOE will review the study and make recommendations for action.

Several new laws were also passed that affect mathematics testing and accountability. SB 149, authored by Sen. Kel Seliger (R-Amarillo), allows school districts to create high school graduation committees for certain 11th and 12th grade students. If a student passes at least 3 out of the 5 required STAAR EOC's, the district may create an individual graduation committee for that student to determine alternate ways of demonstrating that the student knows the content required by the TEKS for that course. SB 149 took effect in the spring of 2015 with the graduating class of 2015. HB 2349, authored by House Public Education Chair Jimmie Don Aycock (R-Killeen), allows TEA to defer the release of STAAR tests as necessary to develop new items.

SB 934, authored by Sen. Lois Kolkhorst (R-Brenham), authorizes Commissioner Williams to create and implement professional development academies for mathematics teachers in grades K-3. Priority for attending the academies will be given to teachers on campuses that have more than 50% of students classified as economically disadvantaged and stipends will be given to teachers who attend the academies. More information about the new math academies for grades K-3 will be available from TEA soon.

Detailed information about these bills, as well as other bills affecting education, can be found on the Texas Legislature's website, *<http://www.capitol.state.tx.us/>* Home.aspx. TEA also publishes a legislative briefing booklet, which is available on their website, *<http://tea.texas.gov/Reports_and_Data/Legislative_Reports/Legislative_Briefing_Book/>* .

Actions from the State Board of Education

The State Board of Education (SBOE) has approved two new high school mathematics courses. Statistics (non-AP course) was approved in February and Algebraic Reasoning was approved in April. Both of these courses were created to provide schools with the opportunity to offer additional courses that do not require Algebra 2 as a prerequisite. Both Statistics and Algebraic Reasoning satisfy the advanced mathematics requirement in the Foundation diploma. Both courses are also eligible for additional mathematics credits that may be required in any endorsement. TEKS for these courses are available on the TEA website, *<http://ritter.tea.state.tx.us/rules/tac/chapter111/ch111c.html>*.

At their July meeting, the SBOE also approved a new Career and Technical Education (CTE) course, Financial Mathematics. The goal of the SBOE is that this course will satisfy a mathematics graduation credit requirement. It will be determined at a future SBOE meeting whether Financial Mathematics will apply toward the Foundation diploma or an endorsement.

The SBOE also amended Proclamation 2017 to include instructional materials for all three of these new high school mathematics courses. Educators are being sought to review instructional materials during the summer of 2016 for preview and adoption during the 2016-17 school year. Schools will implement instructional materials adopted under Proclamation 2017 in the 2017-18 school year. If you or a colleague are interested in serving on the educator review committees for Proclamation 2017, TEA will post nomination forms on their website in September. Nominations are due to TEA in January 2016.

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Student Activity

A Stick Game

Long ago, Native Americans played games with sticks. Have fun playing this stick game.

First write the name of a Texas river on one side of three craft sticks in the following manner:

Stick 1—one Texas river

Stick 2—another Texas river

Stick 3—a third Texas river

To play the game, you will be throwing the sticks in the air and seeing which side lands facing up. Before you begin, write all the different ways the sticks might land. You may use the first letter of each word. Example: *t* for Trinity River, *r* for Rio Grande, *c* for Colorado River, *g* for Guadalupe River (there are MANY others).

Write the combination you think will occur most often. _____

Now throw the sticks ten times and record how they land.

	Stick 1	Stick 2	Stick 3
1			
2			
3			
4			
5			

	Stick 1	Stick 2	Stick 3
6			
7			
8			
9			
10			

What were your results?

_____

_____

_____

_____

Another Stick Game

Stick #	Front side		Back side	
1	one Texas river	(a)	Same as front of stick 2	(b)
2	another Texas river	(b)	Same as front of stick 1	(c)
3	a third Texas river	(c)	Same as front of stick 1	(a)

Students should work in pairs for this activity. Each pair should dump their three sticks. (it works well to shake them in a big cup and then dump them out). Student A earns a point if any two letters match. Student B earns a point if all three letters are different. Repeat this 20 times and record results. Discuss results in class, including whether or not this is a fair game. Upper grade students may provide tree diagrams or other support for their explanations.

Still Another Stick Game

Draw two parallel lines on the paper (news print) that are about 1.5 times as far apart as the length of the craft stick. Drop the stick onto the paper from a height of about 1 meter. Record on a chart how many times the stick touches a line or does not touch a line. After a certain number of trials figure the probability that the stick will touch a line when dropped. Does it make a difference if the stick is longer or shorter? What would happen if the stick does not land on the paper?

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Pythagoras
(c. 570 – c. 495 BC)

About This Publication

Since 1971, the Texas Council of Teachers of Mathematics (TCTM) has produced the journal *Texas Mathematics Teacher* for our members. Our mission is to promote mathematics education in Texas. In the journal we accomplish this by publishing peer-reviewed articles by leading authors and local news from around the state. TCTM is committed to improving mathematics instruction at all levels. We place an emphasis on classroom activities that are aligned to the Texas Essential Knowledge and Skills and the NCTM *Principles and Standards for School Mathematics*.

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. Teachers are encouraged to submit articles for Voices From the Classroom, including inspirational stories, exemplary lessons, or management tools. More specific guidelines for submissions may be found below.

Original artwork on the cover is another way teachers may contribute. We publish the journal twice each school year, in the fall and spring semesters. Our website archives the journals in PDF format. Please see

<*www.tctmonline.net*>

if you wish to view prior issues.

Our current Editorial Board consists of Cynthia Schneider, Mary Alice Hatchett, Geoffrey Potter, Larry Lesser, James Epperson and Katey Arrington. Larry, James and Katey serve as expert advisors; Cynthia is the editor. Mary Alice does many jobs, including requesting articles, serving as an elementary expert, and communicating with authors. Geoff is the layout and graphic designer; he manages to fit all the text into the limited number of pages we have to work with. The TCTM Board wishes to thank them for their leadership in producing the *Texas Mathematics Teacher*.

Advertising Guidelines for Texas Mathematics Teacher

All advertising is subject to the approval of the publisher. The journal staff shall be responsible for ascertaining the acceptability of advertisements. All advertisements should be sent "copy-ready" by the closing dates of September 1 for the fall issue and January 15 for the spring issue. Position preference, such as right-hand pages or first half of issue will be honored on a first-come basis. All advertisements must be pre-paid by the closing date with a check made payable to TCTM, and mailed to our current treasurer, Kathy Hale. Rates for *Texas Mathematics Teacher* per issue are: full page $500.00, half page $300.00, quarter page $200.00.

All advertisers must adhere to the guidelines posted on our website at <*www.tctmonline.org*>.

Editorial Board

Texas Mathematics Teacher (ISSN# 0277-030X), the official journal of the Texas Council of Teachers of Mathematics (TCTM), is published in the fall and spring. Editorial correspondence should be mailed or e-mailed to the editor.

This journal is funded by the Texas Council of Teachers of Mathematics and printed at The University of Texas at Austin, which does not imply endorsement by the University or by the Charles A. Dana Center.

Call For Articles

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. Advertisements do not imply endorsement by TCTM's board, editorial staff or members.

Deadline for submissions: Fall/Winter, July 1
Spring/Summer, January 1

TCTM 2015 Mission, Focus and Goal Statements

Mission of the Texas Council of Teachers of Mathematics:

To promote mathematics education in Texas

To support this mission, TCTM has five **focus areas:**

Recruit and Retain Mathematics Teachers	Curriculum and Instruction Support	Advocacy	Promote Communication among Teachers	Serve as Partner Affiliate for NCTM

TCTM activities will align to the five strategic goals. **Goals** of the organization include six strands:

Administration

- Streamline online membership registration through CAMT

Publications

- Survey membership to identify what they want in the *Texas Mathematics Teacher* (*TMT*)
- Review and refine the *TMT* journal and the TCTM website
- Improve the review protocol, establish criteria for reviewers
- Provide tips for new teachers in the *TMT* and on the website

Service

- Increase the donations toward Mathematics Specialist College Scholarships
- Staff CAMT with volunteers as necessary
- Advertise affiliated group conferences on the TCTM website, in the *TMT* and at CAMT

Communication

- Maintain an e-mail list of members for timely announcements
- Communicate with affiliated groups in a timely manner

Membership

- Encourage affiliated groups to include TCTM registration on their membership forms

Public Relations

- Sponsor and staff the TCTM booth at CAMT
- Follow NCTM Advocacy Toolkit (2004) for increased voice of TCTM membership on issues relevant to our mission

TCTM Past-Presidents

1970-1972	James E. Carson	1984-1986	Ralph Cain	1998-2000	Pam Alexander
1972-1974	Shirley Ray	1986-1988	Maggie Dement	2000-2002	Kathy Mittag
1974-1976	W. A. Ashworth, Jr.	1988-1990	Otto Bielss	2002-2006	Cynthia L. Schneider
1976-1978	Shirley Cousins	1990-1992	Karen Hall	2006-2008	Jo Ann Wheeler
1978-1980	Anita Priest	1992-1994	Susan Thomas	2008-2010	Paul Gray
1980-1982	Patsy Johnson	1994-1996	Diane McGowan	2010-2012	Nancy Trapp
1982-1984	Betty Travis	1996-1998	Basia Hall	2012-2014	Mary Alice Hatchett

The Conference for the Advancement of Mathematics Teaching

2016 Henry B. Gonzalez Convention Center San Antonio, Texas June 29-July 1

2017 Fort Worth Convention Center & Omni Hotel Fort Worth, Texas July 10-12

2018 George R. Brown Convention Center Houston, Texas July 16-18

For more details, visit the CAMT website at *<www.camtonline.org>*.

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Texas Mathematics Teacher
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Austin, TX 78701

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Mark your calendar for these important dates!

Central Texas CTM Fall meeting	Baylor University Waco, TX	***October 13, 2015***
Austin Area CTM	Murchison Middle School, Austin ISD	***October 17, 2015***
Rio Grande Valley CTM	University of Texas – Pan American Edinburg, TX	***November 7, 2015***
2016 Texas STEM Conference	San Antonio, TX	***January 21-23, 2016***
Central Texas CTM Spring Conference	University High School Waco, TX	***January 23, 2016***
NCTM Regional Conferences	Atlantic City, NJ	***October 21–23, 2015***
	Minneapolis, MN	***November 11–13, 2015***
	Nashville, TN	***November 18-20, 2015***
NCSM Annual Meeting	Oakland, CA	***April 11-13, 2016***
NCTM Annual Meeting and Exposition	San Francisco, CA	***April 13-16, 2016***
CAMT 2016	Henry B. Gonzalez Convention Center in San Antonio, TX	***June 29-July 1, 2016***