Texas Mathematics Teacher

Volume LX Issue 1 Spring/Summer 2013

Find the Mathematics...

... in a flower!

see page 11

photo by Mary Alice Hatchett

Thirds
A Student Activity
see page 15

Find and Solve the Equation
Scavenger Hunt
see page 11

Puzzle Corner
and Quotes
see page 10

http://www.tctmonline.org/

Texas Council of Teachers of Mathematics
Executive Board 2012 - 2013

Elected Offices (Voting Members)

President (2014)
Mary Alice Hatchett
20172 W. Lake Pkwy.
Georgetown, TX 78628-9512
mahat@earthlink.net

VP-Elementary (2013)
Juli D'Ann Ratheal
4901 E. University Blvd.
Odessa, TX 79762
ratheal_j@utpb.edu

VP-Secondary (2014)
Pam Johnson
504 Caribbean Drive
Lockhart, TX 78644
pjohnso2@austinisd.org

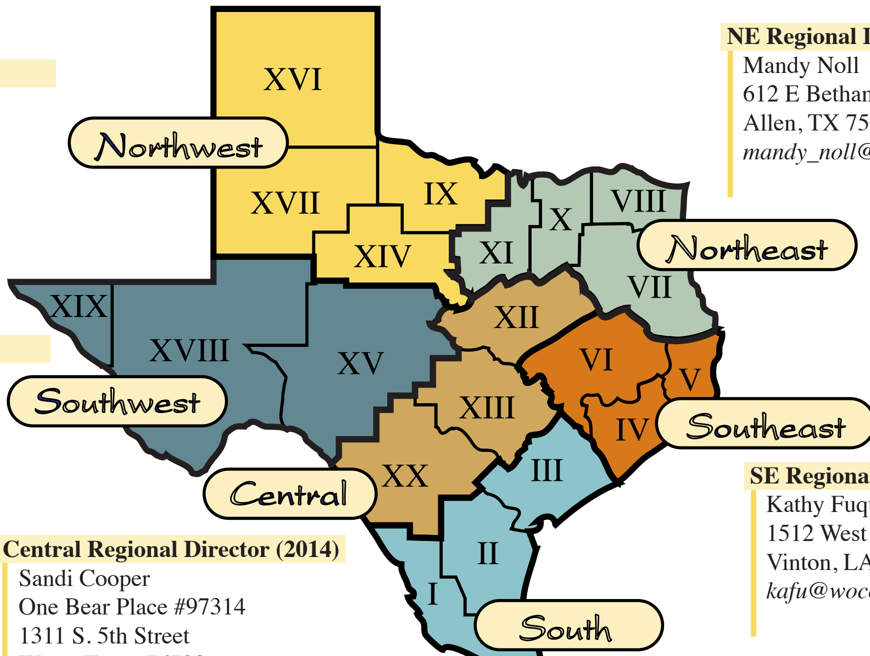
Past-President (2013)
Nancy Trapp
15609 Brandt SR
Raymondville, TX 78580
ntrapp@vtxb.com

Secretary (2014)
Faye Bruun
711 N. Carancahua
Corpus Christi, TX 78401
Faye.Bruun@tamucc.edu

Treasurer (2013)
Martha Godwin
PO Box 82
Queen City, TX 75572
mgodwin@qcisd.net

NW Regional Director (2014)
Sherry Clark
5800 Bell Street
Amarillo, TX 79121
sherry.clark@esc16.net

NE Regional Director (2014)
Mandy Noll
612 E Bethany Dr.
Allen, TX 75002
mandy_noll@allenisd.org



SW Regional Director (2013)
Veronica Hernandez
6611 Boeing Dr.
El Paso, Texas 79925
vhernandez@esc19.net

SE Regional Director (2013)
Kathy Fuqua
1512 West St.
Vinton, LA 70668
kafu@woccisd.net

Central Regional Director (2014)
Sandi Cooper
One Bear Place #97314
1311 S. 5th Street
Waco, Texas 76798
Sandra_Cooper@baylor.edu

South Regional Director (2013)
Shere Salinas
801 Leopard Street
Corpus Christi, TX 78403
Shere.Salinas@ccisd.us

Appointed Offices

CAMT Board Rep [2013]
Cynthia L. Schneider
10015 Derecho Dr
Austin, TX 78737
cschneider@utexas.edu

CAMT Board Rep [2014]
Paul Gray
11902 Ashcroft Dr.
Houston, TX 77035
pgray73@sbcglobal.net

CAMT Board Rep [2015]
Nancy Trapp
15609 Brandt SR.
Raymondville, TX 78580
trapp@vtxb.com

NCTM Rep [2014]
Veronica Galvan
23377 E. Brown Tract Rd
San Benito, TX 78586
galvan_veronica@yahoo.com

Journal Editor [2014]
Cynthia L. Schneider
10015 Derecho Dr
Austin, TX 78737
cschneider@utexas.edu

Director of Publications [2014]
Mary Alice Hatchett
20172 W. Lake Pkwy.
Georgetown, TX 78628-9512
mahat@earthlink.net

Parliamentarian [2014]
Linda Shaub
1111 Highland Hills
Marble Falls, TX 78654
lshaub@ipsi.utexas.edu

Government Relations Rep [2014]
Cynthia L. Schneider
10015 Derecho Dr
Austin, TX 78737
cschneider@utexas.edu

Membership Chair [2014]
Martha Godwin
PO Box 82
Queen City, TX 75572
mgodwin@qcisd.net

CAMT Volunteer Chair [2014]
Kelly Meshell
201 Llama Loop
Kyle, TX 78640
KMeshell@austinisd.org

Liaisons

NCTM ASC Representative for the Southern 2 Region
E. Jean Ware
2114 East Algonquin Trail
Shreveport, LA 71107-5404
ejeanware@aol.com

Texas Mathematics Teacher

A PUBLICATION OF THE TEXAS COUNCIL OF TEACHERS OF MATHEMATICS

Volume LX Issue 1 **Spring/Summer 2013**

cover photo Mary Alice Hatchett

Articles

Features

Departments

TCTM Applications

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

Letter from the President

Dear TCTM colleagues,

As a teacher we play a major role in the development of our society. We inspire, motivate and pass on knowledge. It's important to remember that each day we learn and teach one another whether in a classroom, at work, at home, or at a conference such as the Conference for the Advancement of Mathematics Teaching (CAMT). CAMT is the perfect time and place to learn new lessons, explore technology, examine resources, renew partnerships and meet new colleagues. During the TCTM business meeting/reception at CAMT we honor award recipients, announce grant winners, give away door prizes, and have a little MATH fun! It is an event not to be missed!

The end of summer is fast approaching and that means it is time to gear up for back to school by preparing for a successful year from the beginning. Here are a few tips to keep in mind:

- Pull out those valuable lessons/activities that you learned this summer and brush up on your plan to implement them.
- Remember to stay positive and focus on student achievement.
- Without lowering your expectations, provide opportunities for ALL students to experience success.
- Be excited about what you are teaching. Your enthusiasm is contagious! If you are enthusiastic about learning then your students will be too.
- Keep seating charts up-to-date and handy. Not only will this help in taking attendance but will help you quickly learn student names and is invaluable to substitutes.
- Take time to think about what your classroom management strategies will be. Decide what is and is not acceptable in your classroom and how you are going the handle different scenarios.
- Finally, let go of the things that don't really matter. Be aware of what you are spending your time on as a teacher. Decide what is producing the least gains for your students and eliminate them in order to make time for more productive tasks or, equally important, time for yourself!

Teach well and remember each student in your classroom is somebody's whole entire world.

Sincerely,

Mary Alice Hatchett
TCTM President
<mahat@earthlink.net>

Website: *<www.tctmonline.org>*

Facebook: *Texas Council of Teachers of Mathematics*

Twitter: *< tctmonline >*

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.

Lone Star News

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 available on the NCTM website, <*www.nctm.org*>. Contact information for regional directors is located on the inside front cover.

NORTHWEST REGION — *Service Centers 9, 14, 16, 17*

Sherry Clark, Regional Director

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*> .

SOUTHWEST REGION — *Service Centers 15, 18, 19*

Veronica Hernandez, Director

Greater El Paso CTM
Contact: GEPCTM President, Craig Rhoads, <*crhoad@sisd.net*>

SOUTHEAST REGION — *Service Centers 4, 5, 6*

Kathy Fuqua, Regional Director

Fort Bend CTM
Contact: Alena McClanahan, <*alena.mcclanahan@fortbend.k12.tx.us*>.

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
Contact: Faye Bruun, <*faye.bruun@tamucc.edu*>,
or visit <*cctm.tamucc.edu*>.

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: Lucy Munoz at <*hlucymh@aol.com*>,
or visit <*www.rgvctm.org*>.

CENTRAL TEXAS REGION — *Service Centers 12, 13, 20*

Sandi Cooper, Regional Director

Austin Area CTM
Contact: President Ludy Silva, <*ludysilva2@gmail.com*>,
or visit <*www.aactm.org*>.

Alamo District CTM
Contact: ADCTM president Linda Gann, <*Linda.Gann@nisd.net*>.

Central Texas CTM
Contact: President of CTCTM Sandi Cooper,
<*sandra_cooper@baylor.edu*>, or visit <*www.ctctm.org*>.

STATEWIDE

Texas Association of Supervisors of Mathematics (TASM)
Contact: Cathy Banks <*cbanks@twu.edu*>
Visit <*www.tasmonline.net*>.

The Association of Mathematics Teacher Educators of Texas (AMTE-TX)
Contact Trena Wilkerson at <*Trena_Wilkerson@baylor.edu*>,
or visit < *www.amte-tx.org*>.

NATIONAL

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

$T = \$50,000(1.03)^5$

Math Video Games: Do they Improve Students' Math Test Scores?

Abstract

This quantitative study focused on examining the difference on achievement between a group of fifth-grade students that spent time playing educational video math games and a group that did not. This small study found playing math video games may have a positive impact on students' math scores, as more students that played the games received commended status from TEA for their performance on their math test than students that did not.

Technology is an integral part of many of our students' lives. Today, computers, iPads, smart phones, etc. are how students communicate, play, and learn. Research is starting to show that there are both negative and positive roles that technology plays in the learning processes (Levin, & Arafeh, 2002; Schofield & Davidson, 2002) and that integrating technology into curricular areas can be used to both assess students and change how the content is taught (Kozma, 2003; Means, Penuel, & Padilla, 2001). However, there does not appear to be any research on the impact of educational video games on students' mathematics standardized test scores.

Review of Literature

Technology can be used to transform the classroom-learning environment but much depends on how the teachers use technology in their classroom (Bransford, Brown, & Cocking, 2000). As many students today are digital natives, it is only natural for teachers to research how they can use technologies to increase student engagement and improve student achievement (Kulik, 2002). The use of technology in the mathematics classroom depends on several factors, including:

- Teachers' beliefs about the use of technology for instructional purposes (Ertmer, 2005), as well as their technology skills (Byrom & Bingham, 2001; Coppola, 2004)
- Level of students' mathematical learning ability (Augustyniak, Murphy, & Phillips, 2005); and
- Students' use of video games (Prensky, 2006; Hamlen, 2009; Hoffman & Nadelson, 2009)

Teachers' Beliefs about Technology and Their Technology Skills

Ertmer (2005) stated, "if we truly hope to increase teachers' uses of technology, especially uses that increase student learning, teachers' current classroom practices must be [considered and explored] as they are rooted in, and mediated by, existing pedagogical beliefs" (p. 36). Technology can "offer a versatile and effective support for instructional presentations" (Lever-Duffy, McDonald, & Mizell, 2005, p. 303). However, teachers' beliefs take time to change and will not change unless professional development sessions are carefully planned to include both modeling and scaffolding the use of technology to improve teaching instruction (Ertmer, 2005). Additionally, careful curriculum planning at the district level and technology integration training provided by the district are factors that significantly help in the teaching process. However, technology use varies from school to school due to a districts' ability to purchased technology equipment and to the teachers' skills and abilities to incorporate technology into their lessons. One study found that preservice teachers were not proficient with technology nor did they have the "techno-pedagogical ability to integrate technologies into their teaching practice" (Karsenti, 2001, p 35). Another study found that many teachers feel comfortable using technology for attendance and other organizational purposes but only 39% of classroom teachers reported feeling comfortable enough to use technology as an instructional tool (Grunwald Associates, (2010).

Students' Learning Abilities Applied to Mathematics Learning

While technology integration is very important, one needs to keep in mind the diversity of the student population. Students with learning disabilities, ESL students, students with low computer skills, or students with low mathematics skills require more attention to details from their math instructors. According to Augustyniak, Murphy and Phillips

(2005), teachers should be able to "demonstrate a math problem using technology to help students visualize the problem, to help students understand the meaning of difficult terminology, [and] to provide drill and practice to reinforce mathematical concepts being learned" (p. 282). However, teachers should review software to make sure that any math program used provides both challenge and drill in the required skills.

Video Games in Education

While some research suggests that extensive exposure to television and video games negatively impacts students attention (Swing, Gentile, Anderson, & Walsh, 2010) the questions of what motivates students to engage in these activities is still not completely answered. The American Academy of Pediatrics (AAP) recommend that children not spend more than two hours per day involved in watching television and/or playing video games (AAP, 2013). However, Prensky (2006) believes that even though students play video games for recreational purposes, they could and should be used for educational purposes. Research has shown that computer-based video games improve students' fast recall processes, as well as their problem solving skills (Chuang & Chen, 2009).

Purpose of Study

Angelone (2010) suggests rethinking the possibilities of video games for learning, highlighting specifically teachers' careful planning, and facilitating of games for learning so that content standards and learning objectives can be incorporated together with critical thinking skills. It is necessary to research video game playing to find out if it has a positive impact on both motivating students and helping them to learn necessary math skills to pass state mandated tests. The following question was created for this study:

> To what extent does the use of video games impact students' performance on mathematics achievement tests?

Method

This quantitative study used a control/experimental design to determine if using educational math video games that allow students to practice their math skills impacted students' standardized math scores. The test score data was obtained from the Texas Education Agency (TEA) website while the game data was retrieved from the district technology department which kept the game logs.

Participants

The participants of this study attended non-Title I elementary schools in a large district in North Texas.

Campus A. The experimental group was in a school with a total enrollment of 662. There were 103 fifth-grade students who were tested. This group had 31% economically disadvantaged students. For the ethnicity distribution, there were 9% African American students, 29% Hispanic students, 51% white students, 1% Native American students and 10% Asian students.

Campus B. The control group was in the school with a total enrollment of 674. There were l07 fifth-grade students who were tested. This group had 24% economically disadvantaged students. For the ethnicity distribution, there were 11% African American students, 19% Hispanic students, 59% white students, 2% Native American students and 9% Asian students.

The fifth-grade participants who were in the experimental group were purposefully chosen because Campus A was chosen by the superintendent to use the math video game program during computer time. Campus B was chosen as the control group as the campus was similar in enrollment and demographics to Campus A.

Mathematical Video Game Software

The software is a mathematical video game program that allows students to quickly amass points and move through levels, which keeps students involved through the use of vivid 3D graphics. Students can challenge other students or play individually to earn tokens for correct answers that allow students to purchase online assets to enhance their online character. Students are encouraged by teachers to create a game room following teacher's instruction. By creating a game room, students enter specifics received from teachers based on the mathematics objective, skill, and level. The objectives, skills and levels are directly correlated with Mathematics TEKS for fifth grade. Each game room can have up to 16 players, which allow differentiating instructions. However, students have an option to create games and play individually to gain practice at desired mathematic skills. In order to gain points, and progress in the game, a student must successfully answer a question or solve a problem. Without providing a correct answer, the student is not able to successfully continue the game and gain points.

Data Analysis

The game program recorded the amount of time spent playing the video game in school as well as the number of games played. The data retrieved were cumulative. The math scores were obtained from the TEA website while the video game scores were obtained from the school district technology office. Descriptive statistics (mean) and a z-test were used to examine the results.

Results

Video Game Time

According to the video game program, the fifth grade students from Campus A collectively played 2896 mathematical video games for 284 hours and 55 minutes (17,095 minutes). This means that, on average, each student played 29 mathematical video games for 166 minutes, or a little less than 3 hours.

Standardized State Math Scores

According to the TEA website, both campuses had similar numbers of students who met the necessary math standards. Campus A, the experimental group, had 102 students (99%) who met the math standards at the recommended level while Campus B, the control group, had 105 students (98%) who met the math standards' recommended level. As there was some percentage difference, a z-test was performed but there was no statistically significant difference between the two groups.

Next, the percentage of the students who received a commended status from TEA was examined. There were 69 students from Campus A (67%) and 51 students from Campus B (48%) who received commended, so a z-test was used to examine the differences. With the confidence level of 99%, it is concluded that there is a significant difference between these two groups.

Conclusions

There were some interesting results with this study; however, there are several limitations that need to be kept in mind. First, this study was limited to fifth grade students, as they were the grade-level that was chosen to pilot the video game by the superintendent. Second, this study was done with students on a non-Title I campus in a large northeast Texas suburban school district and can only be generalized to that population.

The analyzed data clearly showed that there was no significant difference between the two groups of fifth grade students who met the recommended math passing standards on the standardized math scores. However, the data analysis on commended status by the fifth grade students who had taken the mathematics TAKS test clearly showed a statistically significant difference. Thus, to answer the research question, it was found that the mathematical video game program that was used might have made a difference on student's math performance.

Implications and Future Research

Even though this is the first year this school district used the mathematical video game program during computer time, there were some promising results, as more students received the commended status from the state department of education for the math scores. Thus, it appears that technology may be used to improve math skills.

Future research could include the following questions. First, does playing video math games for more than 3 hours of computer time help more students receive commended status on their math test scores? Second, do students' math scores who played the highest number of video math games differ from those students who played the lowest number of math games? Third, are more math objectives (or TEKS) mastered if more math video games are played? Fourth, for students within different groups (e.g., economically disadvantaged, ethnicity, gender, etc.) does playing math video games make a difference?

REFERENCES

American Academy of Pediatrics (2013). Children, Adolescents, and Television. Retrieved from: http://pediatrics.aappublications.org/content/107/2/423.full.html

Angelone, L. (2010). Commercial video games in science classroom. *Science Scope, 33*(6), 45-50.

Augustyniak, K., Murphy, J., & Phillips, D. (2005). Psychological perspective in assessing mathematic learning needs. *Journal of Instructional Psychology, 32*(4), 277-286.

Bransford, J., Brown, A., & Cocking, R. (2000). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academic Press.

Byrom, E., & Bingham, M. (2001). Factors influencing the effective use of technology for teaching and learning: Lessons learned from the SEIR-TEC intensive site schools (2nd ed.). Durham, NC: SouthEast Initiatives Regional Technology in Education Consortium. Retrieved May 5, 2012, from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te600.pdf

Chuang, T.Y. & Chen, W.F. (2009). Effects of computer-based video games on children: an experimental study. *Educational Technology & Society, 12*(2), 1-10.

Coppola, E. (2004). *Powering up: Learning to teach well with technology.* New York: Teachers College Press.

Ertmer, P. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development, 53*(4), 25-39.

Grunwald Associates (2010). Schools and the Internet. Retrieved from: http://grunwald.com/surveys/si/index.php.

Hamlen, K. R. (2009). Relationships between computer and video game play and creativity among upper elementary school students, *Educational Computing Research, 40*(1), 1-21.

Hoffman, B. & Nadelson, L. (2009). Motivational engagement and video gaming: a mixed methods study. *Education Tech Research Dev, 58*(3), 245-270

Karsenti, T. (2001). From blackboard to mouse pad: Training teachers for the new millennium. *Education Canada,* 41(2), 32-35.

Kozma, R. (Ed.) (2003). *Technology, innovation, and educational change: A global perspective.* Eugene, OR: International Society for Technology in Education.

Kulik, J. (20002). School mathematics and science programs benefit from instructional technology (InfoBrief, NSF 03-301). Washington, DC: National Science Foundation. Retrieved May 5, 2012, from http://dwbrr.unl.edu/iTech/TEAC859/Read/KulikTech.pdf

Lever-Duffy, J., McDonald, J. B., & Mizell, A. P. (2005). Teaching and Learning with technology. San Francisco, CA: Pearson.

Levin, D., & Arafeh, S. (2002). The digital disconnect: The widening gap between internet-savvy students and their schools. Washington, DC: American Institutes for Research. Retrieved May 7, 2012, from http://www.pewinternet.org/Reports/2002/The-Digital-Disconnect-The-widening-gap-between-Internetsavvy-students-and-their-schools.aspx

Means, B., Penuel, W.R., & Padilla, C. (2001). *The connected school: Technology and learning in high school.* San Francisco: Jossey-Bass.

Prensky, M. (2006). *Don't bother me mom – I'm learning!* St. Paul, MN: Paragon House

Schofield, J., & Davidson, A. (2002). *Bringing the Internet to school: Lessons from an urban district.* San Francisco: Jossey-Bass.

Swing, E.L., Gentile, D.A., Anderson, C.A. & Walsh, D.A. (2010). Television and video game exposure and the development on attention problems. *Pediatrics, 126*(2), 214-221.

Jasna Aliefendic, Ed.D.
• Technology Integration and Staff Development Coordinator
Garland ISD • <jaliefen@garlandisd.net>

Susan Szabo, Ph.D. • Associate Professor
Texas A&M University-Commerce • <Susan.Szabo@tamuc.edu>

$6 + M = 16$

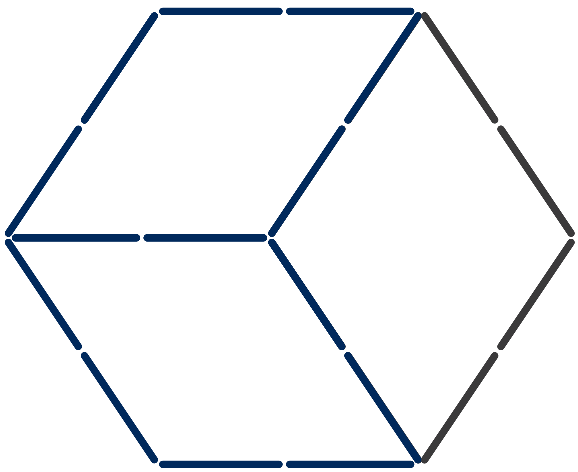
Puzzle Corner

Sticks #20 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 18 craft sticks to form a regular hexagon divided into three congruent regions.

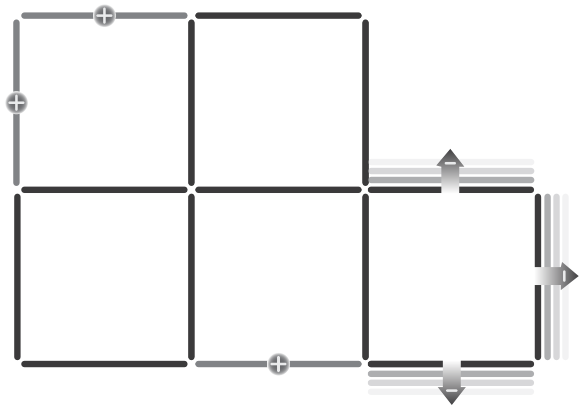


Puzzle: Now move four sticks to divide it into only two congruent regions.

Sticks #19 Answer

Arrange 12 craft sticks to form the original figure. Rearrange three sticks to form a figure that has four congruent squares.

Shown is a diagram of **a solution.**



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

Quotes for Thought

"The important thing is not so much that every child should be taught, as that every child should be given the wish to learn."

Sir John Lubbock
banker, politician, philanthropist, scientist & polymath
(1834 – 1913)

"Life is change. Growth is optional. Choose wisely."

William Somerset Maugham
British playwright, novelist and writer
(1874 – 1965)

"It is important to remember, in all efforts at improving the teaching of mathematics, that we are teaching human beings, and that what we are teaching them is a human activity with uses and with beauty and with surprises."

Edward J. McShane
American mathematician
(1904 – 1989)

On The Cover

Find the Mathematics… in a flower

Texas has many flowering plants. The bloom pictured on the cover was photographed in the Rio Grande Valley, but there are many blooms like it in your area, especially in the spring. According to Wikipedia <en.wikipedia.org/wiki/Flower_petals accessed 062013>:

> Petals are modified leaves that surround the reproductive parts of flowers. They are often brightly colored or unusually shaped to attract pollinators. The number of petals in a flower may hold clues to a plant's classification. For example, flowers on eudicots (the largest group of dicots) most frequently have four or five petals while flowers on monocots have three or six petals, although there are many exceptions to this rule.
>
> The petal whorl or corolla may be either radially or bilaterally symmetrical (see Symmetry in biology and Floral symmetry). If all of the petals are essentially identical in size and shape, the flower is said to be regular or actinomorphic (meaning "ray-formed").

Classroom questions for consideration:

1. How many petals does the flower have?
2. Does this flower have an even or odd number of petals?
3. Does this flower have a prime or composite number of petals?
4. Is the number of petals on the flower a Fibonacci number?
5. Look online and learn what other flowers are related to Fibonacci numbers.
6. Estimate what fraction of the flower's petals are yellow.
7. What kind of symmetry do this flower's petals have?
8. Through what angle could you rotate the flower about its stamen and have it look the same?
9. What related connections to the photo do you find in this video: *< http://www.youtube.com/watch?v=lOIP_Z_-0Hs >*
10. How is the first day of spring determined? Is it always March 21?

    For Questions 11-14, put your graphing calculator in polar coordinates mode.

11. Put your graphing calculator in polar coordinates mode and graph $r = \cos(5\theta)$.
12. How is this graph like and not like the flower?
13. Find what formula will produce a flower with, say, 8 petals.
14. What does the graph look like if you allow the number multiplied by theta to be a fraction instead of a whole number?

    For questions 15-17, put your graphing calculator in parametric plot mode.

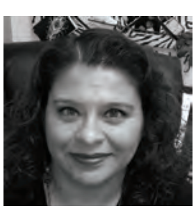
15. Put your graphing calculator in parametric plot mode and graph this pair of equations:
    $x = \cos(5t)\sin(t)$
    $y = \cos(5t)\cos(t)$
16. How is this graph like and not like the flower?
17. Find what formula will produce a flower with, say, 8 petals.

find answers on page 12

Larry Lesser • Mathematics Education Professor
The University of Texas at El Paso • <Lesser@utep.edu>

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

Solve the Equations Scavenger Hunt



Fall 2012 Winner
Cynthia Valdez

Last Issue's Winner

Congratulations to Cynthia Valdez from Link Elementary School, Spring ISD. Cynthia won a $100 NCTM gift certificate. Her name was drawn from the correct submissions to the Name That Date Scavenger Hunt in the Spring/Summer 2012 *Texas Mathematics Teacher*.

Solve the Equation Scavenger Hunt

In this issue you need to find the equations for the Solve the Equations Scavenger Hunt. These equations may be found throughout this issue. Submit the completed equations and their solutioins via email to Mary Alice Hatchett by September 15, 2013 at *<mahat@earthlink.net>*. All correct entries will be entered into a drawing for a $100 NCTM gift certificate. The winner will be notified by October 1, 2013.

On the Cover: Classroom Question Answers

You will find the original questions on page 11.

1. How many petals does the flower have?
5

2. Does this flower have an even or odd number of petals?
odd

3. Does this flower have a prime or composite number of petals?
prime

4. Is the number of petals on the flower a Fibonacci number?
yes

5. Look online and learn what other flowers are related to Fibonacci numbers.
calla lily (1), euphorbia (2), trillium (3), columbine (5), etc.

6. Estimate what fraction of the flower's petals are yellow.
more than a third, less than a half; for example 5/12

7. What kind of symmetry do this flower's petals have?
(Radial or actinomorphic; rotational; turn)

8. Through what angle could you rotate the flower about its stamen and have it look the same?
360° ÷ 5 = 72°

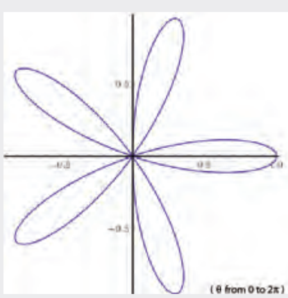
9. What related connections to the photo do you find in this video: *<www.youtube.com/watch?v=lOIP_Z_-0Hs>*
(Various responses)

10. How is the first day of spring determined?
By the vernal equinox, when days and nights are approximately equal everywhere and the Sun rises and sets due east and west.

    Is it always March 21?
    No, Spring does not always begin on March 21.

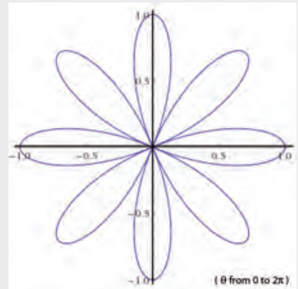
For Questions 11-14, put your graphing calculator in polar coordinates mode.

11. Put your graphing calculator in polar coordinates mode and graph $r = \cos(5\theta)$.



12. How is this graph like and not like the flower?
Like: both have five petals;
Unlike: petals of graph are symmetric across x-axis and petals on flower are broader or wider than petals on graph.

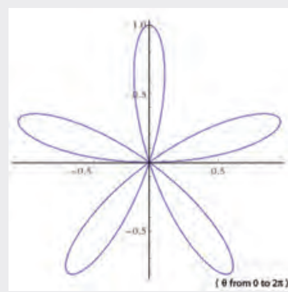
13. Find what formula will produce a flower with, say, 8 petals.
$\boldsymbol{r = \cos(4\theta)}$



14. What does the graph look like if you allow the number multiplied by theta to be a fraction instead of a whole number?
The petals overlap

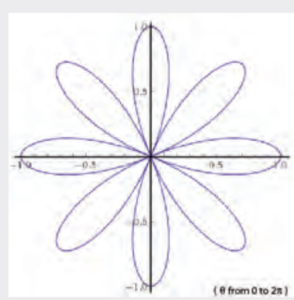
For questions 15-17, put your graphing calculator in parametric plot mode.

15. Put your graphing calculator in parametric plot mode and graph this pair of equations:
$x = \cos(5t)\sin(t)$,
$y = \cos(5t)\cos(t)$.



16. How is this graph like and not like the flower?
Like: both have five petals;
Unlike: graph is symmetric across y-axis and petals on flower are broader or wider

17. Find what formula will produce a flower with, say, 8 petals.
$\boldsymbol{x = \cos(4t)\sin(t)}$,
$\boldsymbol{y = \cos(4t)\cos(t)}$



Voices from the Classroom

How Can Instructional Coaches Support Teachers With the Rigorous Demands of STAAR?

The many unknowns during the 2011-2012 school year made many teachers feel on edge. The transition from TAKS to STAAR had a significant effect on both teachers and students. Teaching to the rigorous level of STAAR required that we expose students to multi-step word problems and supplement instruction with ample preparation time and commitment from teachers. Providing instructional support was a key piece of what made our students successful.

This past school year, support was provided from the district level as well as campus level. A major support that teachers needed this past school year was examples of how to teach student expectations in a variety of rigorous and collaborative ways. District instructional specialists worked closely with campus instructional coaches to make the transition from TAKS to STAAR as easy as possible. As the year progressed, the support was modified to accommodate the teachers' needs.

The support that the teachers received was exceptional. At the district level, teachers were exposed to several resources including an instructional resource with 5E lessons based on the readiness standards. Teachers felt this resource was not only valuable, but also a true exposure of rigorous instruction for the students. Students were able to collaborate with their classmates while learning at an appropriate level for STAAR.

As a campus mathematics instructional coach, I provided teachers with instructional support that included creating common assessments for the mathematics classroom. These ten-item assessments were for Grades 2-4 and were provided in Spanish and English. I also attended several workshops for additional resources. Since time is always an issue for classroom teachers, I collected additional resources and ideas on their behalf. I also created one-page documents that contained common language and instructional examples for each student expectation. This was done to ensure alignment through the grade levels.

I felt that our scores reflected the increased level of support our teachers received throughout the district and at our campus. I know that next school year the success will continue as teachers reach out to the district instructional specialists and campus coaches. Success is a team effort and without a doubt can be achieved with any type of student.

Erica Jeannette Moreno • Mathematics Peer Facilitator
Frazier Elementary, Pasadena ISD
• <marioanderica@hotmail.com>

73,000 - 9,999 = *V*

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: Jo Ann Bilderback, Math/Science Content Specialist at (512) 463-9581 or *<joann.bilderback@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>*.

Application Information

2014-15 Mathematics Preservice Teacher Scholarship

There are ten $2000 scholarships available for 2014-15. Any student attending a Texas college or university - public or private - and who plans on student teaching during the 2014-15 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, 2014. Winners will be announced in July 2014.

TCTM 2014 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, 2013. Awardees will be notified by January 31, 2014.

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*>.

$10^5 \div 10^3 = H$

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!

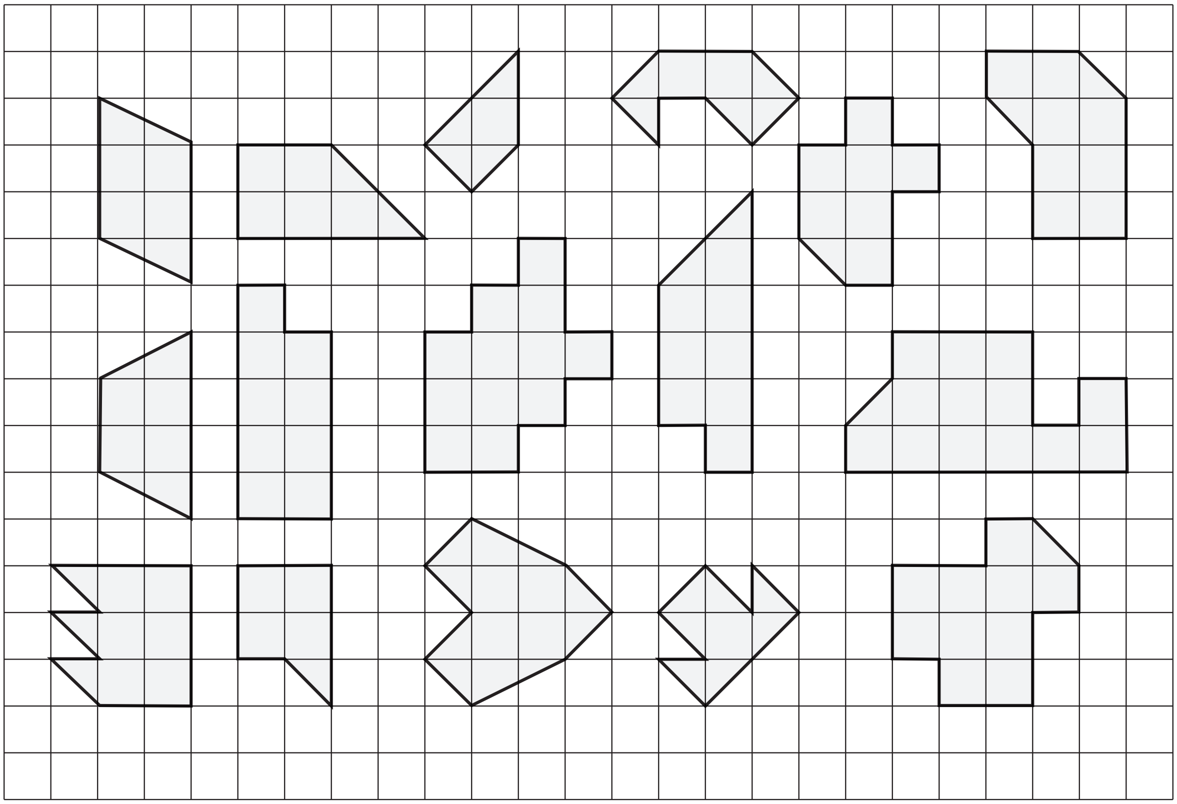
Like the Texas Council of Teachers of Mathematics page on Facebook.

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*> .

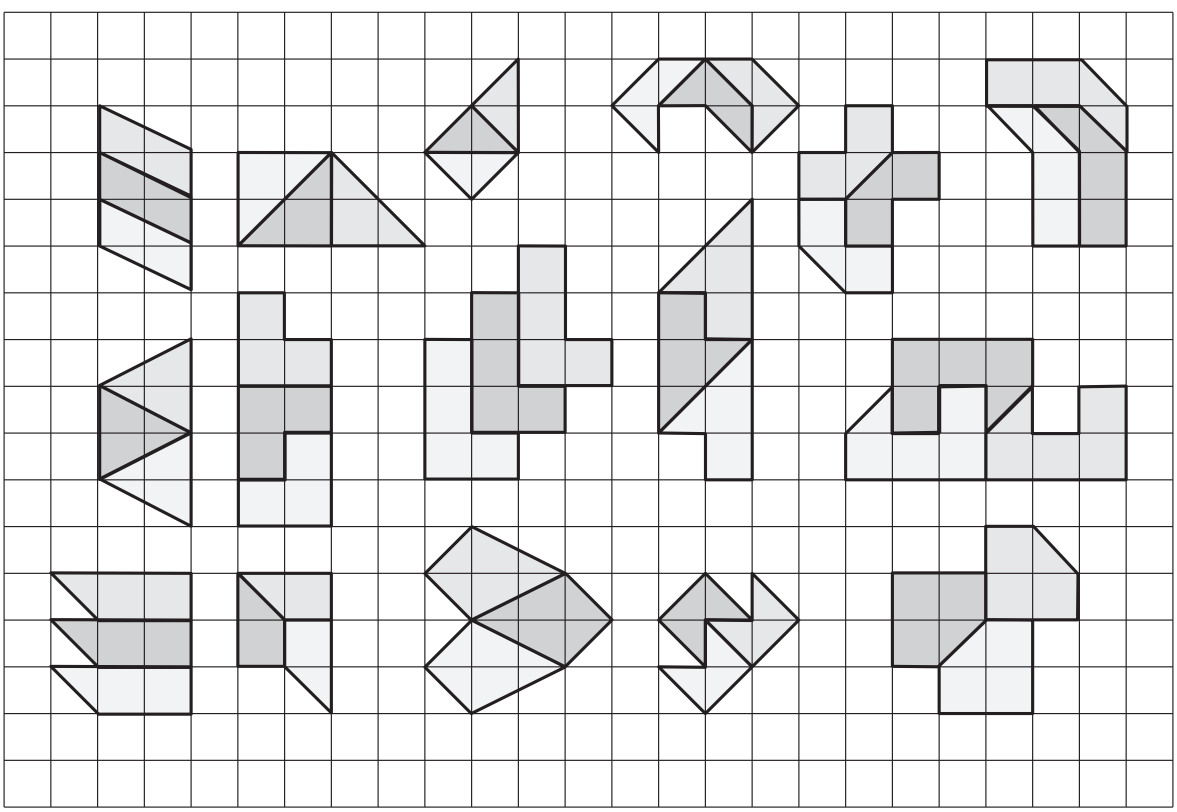
Thirds: A Student Activity

Divide each of these shapes into 3 congruent parts. Some are very hard!



Student Activity Answers

sin (30°) = *S*



Foundations of Cryptography

Cryptography may save your life. It sure did for the following Marines:

> "...a battalion of marines took over positions previously held by Japanese soldiers, who had retreated. Suddenly a salvo exploded nearby. They were under friendly fire from fellow Americans who were unaware of their advance. The marines radioed back in English explaining their position, but the salvos continued because the attacking American troops suspected that the messages were from Japanese impersonators trying to fool them. It was only when a Navajo message was sent that the attackers saw their mistake and halted the assault. A Navajo message could never be faked, and could always be trusted."
>
> "The Code Book" (Singh, 1999, p. 198)

Similar to the Navajo Code used by the Marines, bar codes, credit cards, internet shopping, and ATM machines are a few examples of modern day cryptography used in everyday life. The world would be very different without these simple yet necessary amenities. The story above illustrates an active use of codes in a war setting and thus shows how coding is used in a variety of aspects in life.

Cryptography, "the study of mathematical techniques related to aspects of information security..." (Menezes, 1997, p. 4), has progressed notably over the years, starting from simple codes first used centuries ago and advancing to complex computer coding programs used in everyday life. The mathematics involved can vary from simple numbers to complex equations and puzzles, making codes applicable to multiple stages of learning. Since the mathematics of cryptography is utilized in many common aspects of life, it seems a natural area of study for secondary school mathematics students. Unfortunately, no mention of the topic appears in the Common Core Curriculum Standards for School Mathematics for grades 7-12 (CCSSM, 2010). This article discusses pertinent facets of cryptography that are accessible to secondary school students. We strongly recommend their inclusion in academic standards and school classrooms.

The Caesar Cipher and Modular Arithmetic

This practice of coding and decoding messages is foundational to the cryptographic system and can be traced back to the times of Julius Caesar (Luciano & Prichett, 1987). This system embodied a shift in the alphabet to scramble messages using modular arithmetic. For example, a shift of five would replace the letter A with the letter F. Modular arithmetic implies that the Caesar Cipher is a "wrap around" system, therefore when using the alphabet, the system is based off of a mod(26), or base 26, system. For that reason, once the system reached the equivalent letter to 26, it does not go on to 27 but back to 1.

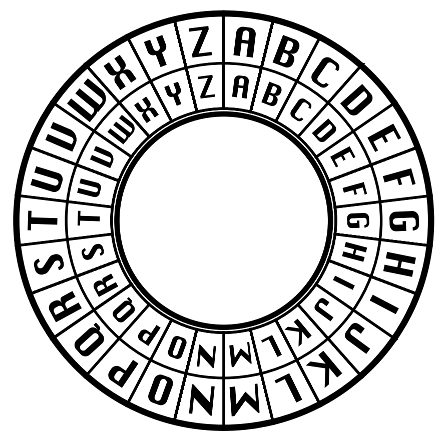


Figure 1. Caesar's Cipher Wheel (Reynard, 1996, p. 50)

Putting this into practice, using the example from above, to allow A=F the system would have to be based off of a mod(5) system, meaning that the letter A was shifted 5 letters to the right matching it up with the letter F. Any shift can be applied to keep the Caesar Cipher functional. This basic concept of number substitution seen in cryptography through modular arithmetic is a critical skill taught in early algebra and geometry and used though many higher forms of mathematics.

Vigenere Cipher

The Vigenere Cipher, created in the 1500s by Blaise de Vigenere, is a poly-alphabetical substitution encryption that utilizes a keyword and multiple mathematical patterns. At first glance, the 26 x 26 table is intimidating and misleading. One notices that the letters repeat in a diagonal pattern but is unsure of how that pattern is used for the encryption of words.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Figure 2. The Vigenere Cipher (R. Morelli, 2010)

This table is composed of multiple Caesar Ciphers. Every row is one linear shift to the left from the previous row. The first row is a shift of 0 letters, the second is a shift of 1, and the last is a shift of 25, which altogether creates 676 letters to use when encoding and decoding messages.

There are different methods when decoding and encoding items using this table. In order to use the Vigenere Cipher, a keyword must be chosen. In this example, the keyword is "KEY" and the phrase is "This is a secret". In one method, the message is broken into sections of five letters to make the words even more difficult to decipher. The keyword repeats based on the length of the plaintext. Using this method, the example reads as follows:

Keyword	KEYKE	YKEYK	EYK
Plain Text	THISI	SASEC	RET
Cipher Text	DLGCM	QKWCM	VCD
Location	01234	56789	012

Using the table in Figure 1, the first letter in the ciphertext, or "D" in the given example, is found by locating the intersection of the first letter in the keyword, or "K," and the first letter in the plaintext, or "T." This process is repeated until the entire text is encoded. See the following figure (Figure 2) for an illustration of the first two letters in this example.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Figure 3. This depicts the method for encoding messages using the Vigenere Cipher.

Navajo Code. A more complex system, the Navajo Code, was used by the United States to communicate messages during World War II. Figure 3 illustrates some common Navajo terms and their English and Spanish translations.

A	*Ant (hormiga)*	Wol-la-chee	**N**	*Nut (fruto seco)*	Nesh-chee
B	*Bear (oso)*	Shush	**O**	*Owl (buho)*	Ne-ash-jsh
C	*Cat (gato)*	Moasi	**P**	*Pig (cerdo)*	Bi-sodih
D	*Deer (cciervo)*	Be	**Q**	*Quiver (carcaj)*	Ca-yeilth
E	*Elk (alce)*	Dzeh	**R**	*Rabbit (conejo)*	Gah
F	*Fox (zorro)*	Ma-e	**S**	*Sheep (oveja)*	Dibeh
G	*Goat (cabra)*	Klizzie	**T**	*Turkey (pavo)*	Than-zie
H	*Horse (caballo)*	Lin	**U**	*Ute (indio Ute)*	No-da-ih
I	*Ice (hiclo)*	Tkin	**V**	*Victor (triunfador)*	A-keh-di-glini
J	*Jackass (burro)*	Tkele-cho-gi	**W**	*Weasel (comadreja)*	Gloe-ih
K	*Kid (chaval)*	Klizzie-yazzi	**X**	*Cross (cruse)*	Al-an-as-dzoh
L	*Lamb (cordero)*	Dibeh-yazzi	**Y**	*Yucca (yuca)*	Tsah-as-zih
M	*Mouse (ration)*	Na-as-tso-si	**Z**	*Zink (zink)*	Besh-do-gliz

Figure 4. Table of common Navajo terms and English and Spanish equivalents (Singh, 1999, p. 196)

Singh (1999) explains the coding process by means of example. He notes that "...the word 'Pacific' would be spelled out as 'pig, ant, cat, ice, fox, ice, cat' which would be translated into the Navajo language" (p. 195). This double-coding method proved to be nearly impossible to decode, making this system very useful in the context of war. At first glance, encoding messages using Navajo appears to involve little, if any, mathematics. However the concepts of finding patterns and the use of separation of larger parts into smaller parts parallels basic mathematical concepts particularly found in the secondary math curriculum. For example, according to the Texas Essential Knowledge and Skills for mathematics students in grades 6-8 should be able to, "use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution," as well as, "apply mathematics to problems arising in everyday life, society, and the workplace" ("Mathematics texas essential," 2012). Cryptography capitalizes on the skills implemented in statewide curriculum as well as provides a concrete example of how math can be used and seen in everyday life.

Public Key Cryptography

Simply based on the definition mentioned earlier, cryptography has always had a mathematical foundation, yet recent advancements in technologies such as the telephone, computer, and internet have changed the system entirely. A major result of technology in cryptosystems is the public key cipher. In their paper "New Directions in Cryptography," Diffie and Hellman (1976) outline this idea of public key ciphers. Unlike the above Caesar and Vigenere ciphers the public key cipher relies on a branch of computer science called computational complex theory. Computational complex theory is involved with the analysis and design of algorithms, especially the number and complexity of the computational step by step processes needed to complete an algorithm (Luciano & Prichett, 1987).

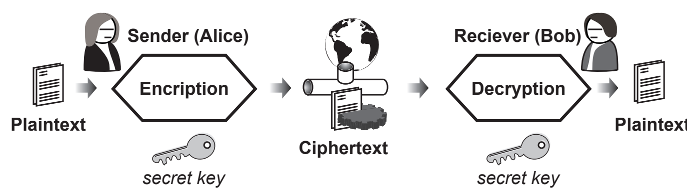


Figure 5. Graphical depiction of encryption and decryption via plain text (Al-Anie, Alia & Hnaif, 2010, p. 90)

Prime Factorization Methods

Cryptography is the foundational reason explaining why credit cards work and are safe to use. A customer's credit card provides an encryption for the store to solve, and through the method of prime factorization the numbers are given meaning. The string of digits that compose a credit card number are made up of certain prime numbers as the coding method. Only the holder of the PIN in accordance with the private key has access to the private information. If the encrypted prime numbers are discovered then the credit card information can be decoded, however this is nearly an impossible feat to someone without the private key making the system extremely secure. The concept of prime numbers and prime factorization within the secondary mathematics curriculum is a key concept, and yet reason why the inclusion of cryptography would be beneficial to students' learning as a whole.

Breaking the Code

The length of the keyword is crucial information when encrypting or decrypting a message. A Prussian major named Kasiski invented a method identifying the length of the keyword and applying frequency analysis to chunks of the message (Morelli). He began with finding pairs of letters that repeated in the ciphertext and counted how far apart the letters were from each other. He then used the factors of that value as indicators for how long the keyword might be. The process of decoding and encoding a message requires a numerical substitution for the 26 letters of the alphabet. The first step to encrypting the message involves substituting every letter with the number that corresponds to its position in the alphabet (A=0, B=1, etc.). The keyword "KEY" translates into 10, 4, 24. With each numerical plain text cipher, the decoder uses a Caesar Cipher to shift that number by the value of the numerical keyword cipher. Once 25 is reached, the decoder begins again at 0. This final value for each original plaintext letter is now the encrypted letter.

	T	H	I	S	I	S	A	S	E	C	R	E	T
	19	7	8	18	8	18	0	18	4	2	17	4	19
+	10	4	24	10	4	24	10	4	24	10	4	24	10
=	3	11	6	2	12	16	10	22	2	12	21	2	3
	D	L	G	C	M	Q	K	W	C	M	V	C	D

To break the Vigenere Cipher, the ciphertext letters are substituted for their numerical replacements, then the keyword numbers are subtracted to result in a number corresponding to the plaintext letters. For example, "D" corresponds to the number 3; subtract 10 for the letter "K" (using the "wrap-around" system starting back at 25) and the result, 19, corresponds to the plaintext letter "T." This method calls for addition and subtraction when breaking each simpler Caesar Cipher. The following link is a fun, technological way for the students to try breaking Vigenere Ciphers:

<http://cryptoclub.math.uic.edu/vigenere/decrypt.php>.

Change in Curriculum

According to the Common Core Curriculum of Mathematics, "Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace." (Common Core State Standards Initiative). Cryptography provides this in the 7-12 curriculum by being a bridge from mathematics to real world application. Along with patterns, the use of equations, prime factorization, solving equations using limited information and other key ideas that are shared by cryptography and mathematics, it would be in alignment with the curriculum standards, as well as helpful for students in relating school material to everyday life to incorporate the topic of cryptography in the secondary mathematics curriculum. For example, modular arithmetic and prime factorization are areas that are familiar to students in grades 7-12. Both topics teach general mathematical ideas that are often introduced in seventh grade mathematics and continually used in higher level classrooms.

Today, knowingly and unknowingly, we use cryptography in a vast number of everyday functions. Ranging from the internet, telephones, and barcodes cryptography is also present in the encryption of music as well as the formation of Braille. It is clear that cryptography influences a wide range of topics therefore including it in the mathematics curriculum would not only connect math to real world problems but also help bridge the connection in many school subjects.

The mathematics, history and the influence of technology are collectively the reason why cryptography is seen as regularly as it is in today's world. While mathematics continues to be the foundation for cryptography, the extended usefulness into everyday life is very clear. The standards expressed in the Common Core have the potential to incorporate cryptography into the 7-12 classroom without much adjustment to the current curriculum. This change would greatly benefit students by aiding in the connection between mathematics and real life problem solving. As an educator, it is critical that this connection is made and strived for in any stage of learning. By incorporating the element of cryptography into the secondary mathematics class curriculum, many opportunities to integrate other subject areas in the mathematics classroom would arise, ultimately aiding students in becoming better learners.

REFERENCES

Al-Anie, H. K., Alia, M. A., & Hnaif, A. A. (2011). E-voting Protocol Based on Public-Key Cryptography. *International Journal Of Network Security & Its Applications*, 3(4), 87-98. doi:10.5121/ijnsa.2011.3408

Common Core State Standards Initiative. (n.d.).*Mathematics: Standards for mathematical practice* . Retrieved from http://www.corestandards.org/Math/Practice

Diffie, W., & Hellman, M. (1976). New directions in cryptography. *Information Theory, IEEE Transactions on*, 22(6), 644-654.

Luciano, D., Prichett, G. (1987). *Cryptology: From caesar ciphers to public-key cryptosystems*. (Vol. 18, pp. 2-17). The College Mathematics Journal Retrieved from http://www.jstor.org/stable/2686311

Marshall, P. D., & Varro, L. (2004). Cracking the code.*10*(1), 54-60. Retrieved from https://dl.dropbox.com/u/1364131/EDT265/FA12/Cryptology/MTMS2004-08-54a.pdf

Mathematics texas essential knowledge and skills. (2012, June 19). Retrieved from http://www.tea.state.tx.us/index2.aspx?id=2147499971

Menezes, A. (1997). *Handbook of applied cryptography*. (p. 4). United States of America: CRC Press LLC.

Morelli, R. "The Vigenere Cipher." *Vigenere Cipher*. Retrieved from http://www.cs.trincoll.edu/~crypto/historical/vigenere.html

Petras, R. T. (2001). Privacy for the twenty-first century: Cryptography. *The National Council of Teachers of Mathematics*, 94(8), 689-707. Retrieved from https://dl.dropbox.com/u/1364131/EDT265/FA12/Cryptology/MT Article copy.pdf

Reynard, R. (1996). Secret code breaker: A crtptanalysis handbook. Jacksonville, FL: Smith & Daniel Marketing.

Singh, S. (1999). *The code book*. New York City: Anchor Books

Jaclyn Deutsch • Middle Childhood Education Student
Miami University • <deutscjn@muohio.edu>

Justin Bultman • Middle Childhood Education Student
Miami University • <bultmajd@muohio.edu>

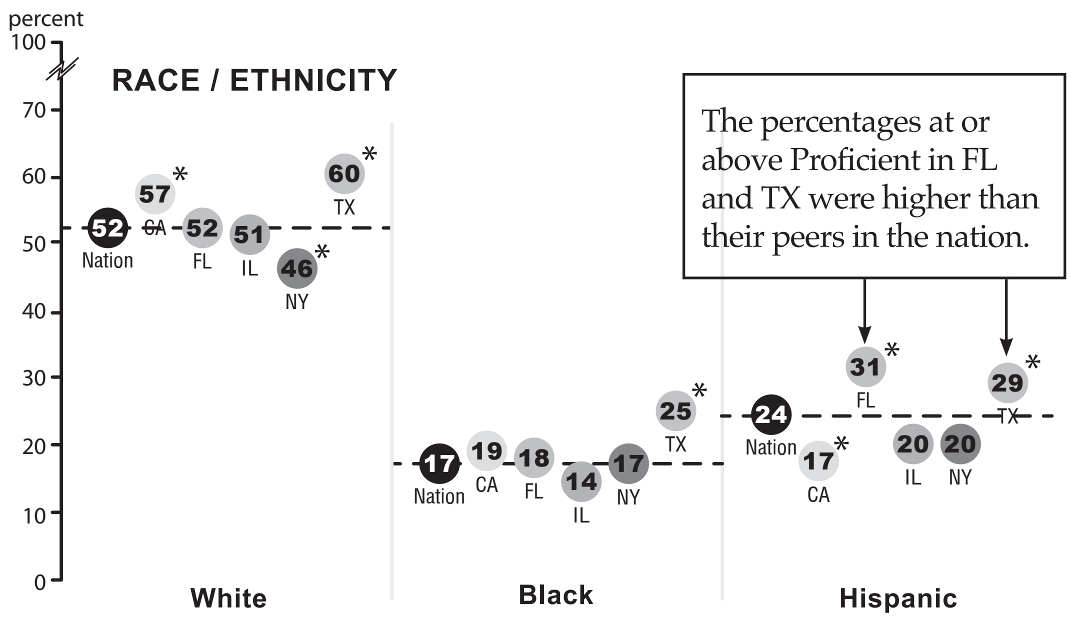
Stephanie Benson • Middle Childhood Education Student
Miami University • <bensonsr@muohio.edu>

How do student groups compare to the nation in performance at or above Proficient?

HOW TO USE THE PROFICIENCY MAP

Numerals in the circles indicate the percentages from each of the student groups performing at or above *Proficient*. Text boxes with arrow indicators highlight examples of the various results in this figure.

Figure M3. Percentage of fourth-grade public school students at or above Proficient in NAEP mathematics, by selected student groups and jurisdiction: 2011



* Significantly different (p < .05) from the nation.

NOTE: *Black includes African American, and Hispanic includes Latino. Race categories exclude Hispanic origin.*

NATION

CALIFORNIA

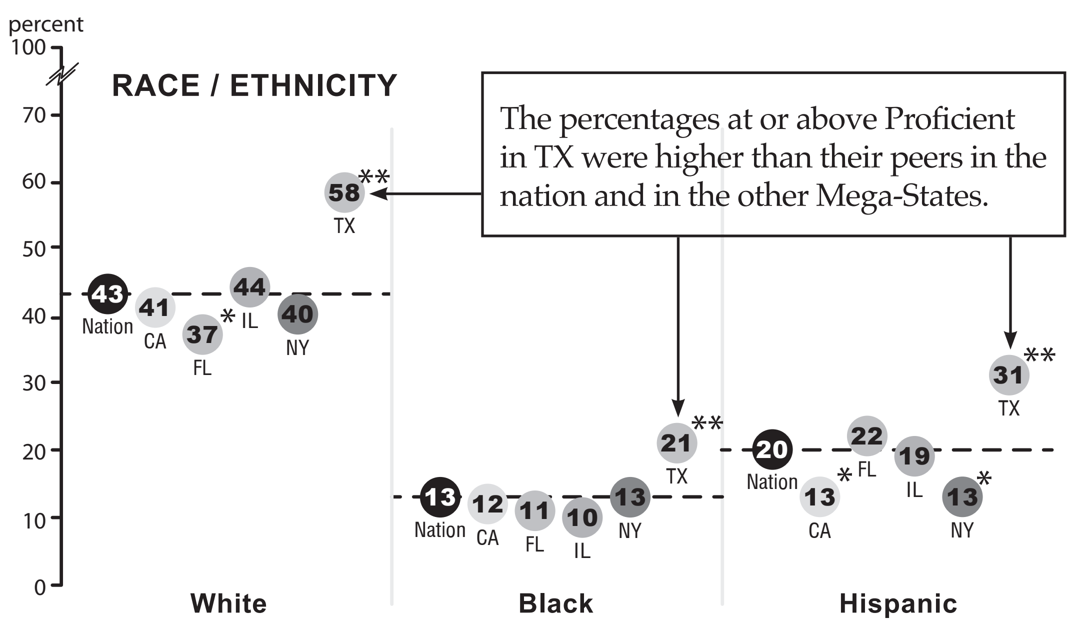
FLORIDA

ILLINOIS

NEW YORK

TEXAS

Figure M6. Percentage of eighth-grade public school students at or above Proficient in NAEP mathematics, by selected student groups and jurisdiction: 2011



* Significantly different (p < .05) from the nation.

** Significantly different (p < .05) from the nation and the other Mega-States.

NOTE: *Black includes African American, and Hispanic includes Latino. Race categories exclude Hispanic origin.*

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2011 Mathematics Assessment.

Three-fourths divided by six-twelths = *F*

2013 TCTM Grant Recipients

Eight 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 *<http://www.tctmonline.org/grant_apply.html>*

Alma Chavez, Pasadena ISD	**Dawn Rogers,** Keller ISD
Darla Heath, Texas A&M Commerce	**Karen Feldman,** Austin ISD
Beth Wiggins, Snook ISD	**Elizabeth L. Brackman-Paniagua,** Northeast ISD
Trena Wilkerson, AMTE-TX	**Sandra R. Rameriz,** Patton Springs ISD

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 2014, please download the forms from our website. Please submit your nomination by Dec. 31, 2013.**

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

2013 TCTM Leadership Award

Vodene Schultz

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

Vodene Schultz started her teaching career in Carlsbad, NM in 1962 beginning with middle school mathematics. Next in the progression was a move to High School Mathematics when a shortage of math teachers led to any certified math teacher being required to move to high school for accreditation purposes. She had to learn to be a good teacher and made her own manipulatives (there were none to be bought) and tried different strategies to ensure that the students understood mathematics. During those years she was active in the New Mexico Council of Teachers of Mathematics, becoming president of the group. Being active in the National Education Association as well led to a term as the New Mexico President which gave her the opportunity to continue to push for good mathematics education. Upon completing that elected position she moved to teach in the El Paso area. First in a private school for three years, then she was recruited to become the math/science specialist at Canutillo ISD. From Canutillo she went to UT-El Paso with the first Urban Systemic Initiative to work with math/science specialists. The focus was on improving elementary teachers content and pedagogy knowledge about math and science. We believed that improvement in elementary math and science would then lead to an improvement in middle and finally high school achievement in math and science.

The superintendent of El Paso ISD then asked Vodene to work in his district to continue the work of improving math education. Choosing to work with elementary teachers helped Vodene understand the challenges in the elementary grades and work for solutions to help the school teach mathematics for understanding. During this time she remained active in the Greater El Paso Area Council, serving as chair of the regional conference in El Paso. She also served on the NCTM materials committee helping to decide on what type of publications to promote. As a sideline to her career in the public schools, she usually taught a math course at either the community college or at UT-El Paso. After her retirement in 2005, she continued to teach a couple of classes for UT-El Paso, usually math methods classes for either middle or elementary teachers.

2013 E. Glenadine Gibb Achievement Award

Dr. Anne Papakonstantinou

TCTM is pleased to honor **Dr. Anne Papakonstantinou** for her leadership at both the state and national levels.

Anne began her teaching career at Sharpstown Senior High School in the Houston Independent School District (HISD) in 1971 where she taught every mathematics course from Fundamentals of Mathematics through BC Calculus and Independent Studies in Mathematics and served as mathematics department chair and Mu Alpha Theta sponsor. She also taught mathematics at the High School for Performing and Visual Arts in HISD and helped open The Rice School/La Escuela Rice as director of curriculum in 1994. As a classroom teacher, she was awarded the Elizabeth Brand Award for Teaching Excellence by the American Association of Petroleum Landmen, was the recipient of the HISD's Teacher of the Year award and the Sam Houston Chapter of the Society of Professional Engineers' Outstanding Mathematics Teacher Award. She also was the recipient of several grants for innovative teaching programs.

In her work as Director of RUSMP, Anne designs and implements district-wide programs that impact the teaching and learning of mathematics and documents their impact on students, teachers, schools, and school districts. She developed a protocol to assess the effectiveness of mathematics programs in schools and districts that is used nationally. She regularly teaches courses for mathematics teachers that demonstrate active learning of important mathematics content. Her other efforts include the Geometry Module for the Texas Higher Education Coordinating Board, The Rice Mathematics Leadership Institute, a seven-year National Science Foundation Mathematics Science Partnership grant, and annual Eisenhower/Teacher Quality grants. She has also taught courses in the Rice University departments of mathematics and education. For her dedication to the university, the Rice University Women's Resource Center presented Anne with its annual IMPACT Award.

Anne serves on numerous advisory boards and committees including The Children's Museum of Houston Education Committee, Houston Education Research Consortium's advisory board, and Harris County Department of Education's Alternative Certification Division advisory committee. Anne also serves on the Algebra I, Geometry, and Algebra II STAAR University content validation panels. She was a member of the Teacher Quality Grants Program Instructional Leadership and Program Evaluation Advisory Committees.

She has served as a table leader for readers for the Educational Testing Service SAT-2 Study, was an Educational Testing Service/The College Board Mathematics Achievement committee member, and served on the National Council of Teachers of Mathematics Professional Development Services Committee. Anne was also a member of the National Science Foundation's three-person team to travel to the Netherlands to research the Dutch's alignment of curriculum, instruction, assessment, and professional development.

Anne co-produced Action Algebra, HISD's weekly television show and taught A. P. Calculus for high school calculus classes locally and state-wide through OWLink, Rice University's interactive tele-distance platform. She co-produced Mathematics in Motion (Best Practices in Algebra I), which was awarded the Texas School Public Relation Association Gold Star Award.

She has been a featured speaker at CAMT over the years and a popular presenter at national conferences.

Anne earned her B.A. in mathematics and French from Rice University, her M.A. in mathematics from Rice University, and her Ed.D. in curriculum and instruction in mathematics from the University of Houston. Dr. Papakonstantinou is the Director of the Rice University School Mathematics Project (RUSMP) and Clinical Assistant Professor of Mathematics at Rice University.

Anne is devoted to her family - her husband Taki, her daughter Joanna, and her kittens, Squeakers and Dorry. Joanna earned four degrees from Rice University including a doctorate in Computational and Applied Mathematics.

PAEMST

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 2013. 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.

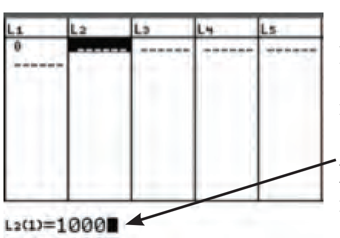
An Analysis of Connections Based on Neuroscience

A Lesson with Connections

Below is a direct teaching lesson on creating the symbolic form of a linear function. It is preceded the day before with a lesson where students are provided numerous real-world contextual data sets (embedded in TI-84 programs or TI-Nspire documents) with the directions to simply identify the shape of the graph and to conjecture when the relationship is increasing and when deceasing. Intravenous drip data are included in the data sets as are a variety of other contexts that give rise to a variety of shapes. Because the algebra to be learned is presented as a simple real-world contextual situation, the mathematics becomes simpler to understand and can be learned faster than without a context as described by Greenspan & Shanker (2004). This particular lesson is the first encounter with the symbolic form of a function following the numeric and graphic forms mentioned above. Symbolic form will be connected to the graphic and numeric forms in the lesson and the I.V. Drip connection is crucial as shown later in the article. Using a graphing calculator provides numerous neurological advantages over pencil and paper or a chalkboard (Laughbaum, 2011).

Sample Lesson:

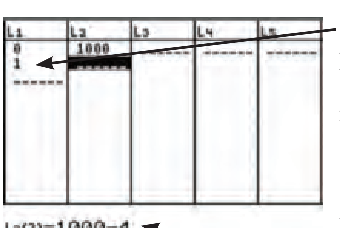
A 1000 ml I.V. drip bag is attached to a patient; the nurse must set the drip rate at 4 ml per minute.



Question: If 0 minutes have passed since starting the I.V. drip, how much fluid remains in the bag?

***Student response*:** Since the bag has 1000 ml to start, at time 0 it must contain 1000 ml.

The idea is to build a pattern so that students will generalize it. When students generalize a pattern, it forms a memory and establishes understanding. (Hawkins, 2004)



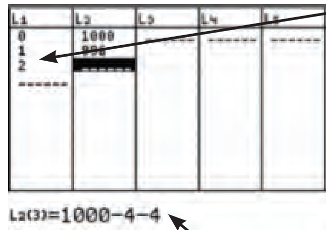
Question: If 1 minute has passed since starting the I.V. drip, how much fluid remains in the bag?

Student response: 996 ml

Question: How did you find that?

Student response: 1000 – 4

Notice the numeric representation being created. This will connect the symbolic model to the numeric representations previously analyzed.



Question: If 2 minutes have passed since starting the I.V. drip, how much fluid remains in the bag?

Student response: 992 ml

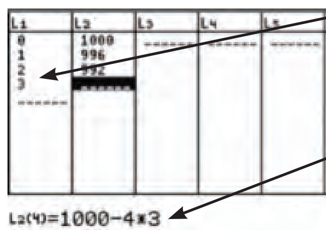
Question: How did you find that?

Student response: (996 – 4)

Question: Ok and how did you get 996?

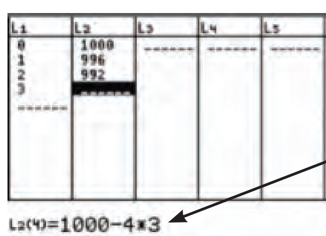
Student response: (1000 – 4) – 4

The idea is to build a table (numeric form) so that students will generalize the pattern that is the symbolic model of the data. Notice the pattern in successive edit lines.



Question: If 3 minutes have passed since starting the I.V. drip, how much fluid remains in the bag?

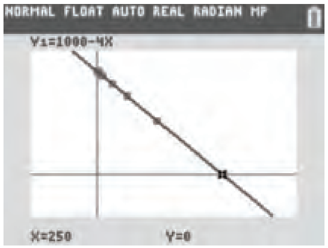
Typically, ***students answer*** 1000 – 4 – 4 – 4 because the average brain generalizes on the third iteration. You direct them to 1000 – 4×3. At this point, try another couple time values to confirm the correct numeric generalization. (Placing 4 before the 3 is significant.)



Once the numerical form of the model has been generalized, the next question to ask is how much fluid remains in the bag after t (or L1) minutes. Having taught this process in 50-75 different classes, the author has never had a class not generalize at this point. There is no need to draw attention to the values in L1. No other clues are needed because of the brain's power to generalize.

The significance of symbols is demonstrated by asking how much fluid remains after 10 minutes, or 60 minutes, or maybe 120 minutes. Ask students for the meaning of (120, 520). Ask what happens at 250 minutes in this contextual situation.

To make connections among representations, graph the data and then the mathematical model with the data. The simultaneity is required to create the connection (neural



association) (McDermott, 2010). Use trace and scroll along the data and then jump to the model for a variety of data points. Connect increasing/decreasing to the situation. Trace to the zero (when the bag is empty). This will prime the students [in a neurological sense] for a lesson on zeros later. On a TI-83/84, a good window is [0, 470] by [−600, 1200]. A good window on the TI-84C is [0, 264] by [−400, 1200]. These are "good" windows because trace yields integer values for x.

The act of tracing on this model with a graphing calculator provides the simultaneous stimuli the brain needs to make connections among three representations of a function. The external stimulus connects the function representations to the real-world context giving the otherwise abstract mathematics a meaning, which is one requirement for understanding (Pinker, 1997; Bergen, 2012). When the bag is empty, the mathematical model has a zero of 250 (minutes). The zero's meaning is a significant emotional tag, and this will increase the likelihood of the memory surviving on a molecular level (Restak, 2006). You must discuss the ramifications of an empty I.V. drip bag to the patient–or the nurse who hung the bag, or the doctor who prescribed the I.V., etc. This simple direct instruction lesson connects mathematical concepts of variable, expression, representation, rate of change, increasing/decreasing, and initial condition to a known real-world context by teaching all concepts simultaneously – a requirement for the creation of neural associations. You may wonder why the formal definitions or words like slope and y-intercept were not included in the above activity. The reason is that concepts and procedures need to be spread out over time while being intermixed with other concepts and procedures. This process is called interleaving. "Interleaving benefits not only memory for what is studied, but also leads to benefits in the transfer of learned skills" (Bjork, 2013).

Neural Associations

When you simultaneously expose the brain to two or more individual and unique concepts or procedures, it automatically creates a neural association, or physical connection, between/among the individual concepts or procedure's memory circuits (Schacter, 2001: Eagleman, 2011: McDermott, 2010). In the case above, new circuitry is created and is connected to the existing circuits. The more neural associations there are to, for example, rate and initial condition, the better the odds are of students remembering them because long-term memory recall is processed through neural associations. "In the cell assembly, all neurons make synapses on all other neurons, so any part of the memory can trigger recall of the rest" (Seung, 2012, p. 72). The point Seung is making is that the connected neural circuitry relative to rate and initial condition are such that activating any of the connected circuitry will likely activate a recall of other circuitry-including the mathematical one you want.

When you think of current curricular models and related pedagogy, you might argue that you are already making connections (neural associations) by using application problems. This may be a true statement, but when you connect the "already learned" symbolic algebra to a new real-world application, the opportunity for learning the symbolic algebra is over. This is significant because the encoding process near the beginning of long-term memory formations is crucial to the durability of a memory (Schacter, 2001). You can affect this memory process through the curriculum and pedagogy by using contextual situations at the beginning of a lesson to actually teach the symbolic algebra in the lesson and in the process create the needed neural association.

Inappropriate Neural Associations Are Possible

The creation of neural associations is an automatic brain function. As such, it may not be good for learning algebra. For example if you are teaching students to factor trinomials for the first time using the abstract pencil-and-paper method, Luke (a student) smells spaghetti cooking from the cafeteria, and his brain may connect the neuronal circuitry being developed for factoring with the circuitry activated by the smell of spaghetti. At the same time, Jennifer (another student) hears the roar of a jet plane and connects the newly forming factoring circuitry with the circuitry activated by a jet engine roar. Rachel, who is thinking about politics, connects the factoring circuitry to her Ronald Reagan circuitry. These connections are not useful to learning, because the automatic connections may not be mathematical in nature, and as such, will likely never be reused in the classroom or curriculum. Fortunately, if these seemingly random connections are not fostered and used, they will be severed very quickly through the "use it or lose it" rule – a dominant function of brain behavior (Taylor & Brock, 2008; Begley, 2007). This provides a strong motivation for curriculum-embedded connections that will be reused.

Neural associations are the mechanism the brain uses to processes long-term memory AND recall. An exception to associative memories is memory created by a strong emotion, which is instantaneous and likely long term. But normally, without neural associations, you cannot store long-term memories or retrieve memories of say, how to factor trinomials since factoring, as typically taught, does not have an emotional connection. Typically, "Memory recall almost always follows a pathway of associations." (Hawkins, 2004, p. 71)

A Core Requirement for Leaning

Neural associations are a required condition for learning and memory (Edelman, 2006). You know how to create them in your students – simultaneously present their brains with two distinct concepts and/or procedures. Lynch & Granger (2008) make the point that "The more a particular set of connections are activated, the more they are strengthened, becoming increasingly reliable [for recall]" (p. 70). You might conjecture that Luke, Jennifer, and Rachel never re-used or experienced their connections more than once, so these connections will be severed soon after their creation; thereby decreasing the ability to recall factoring. On the other hand, what if every algebraic concept or procedure was connected through a common theme running throughout the algebra curriculum, and these common associations are activated daily? With daily use of common theme connections, activating any one of the connected neural circuits will increase the likelihood of bringing the other circuits to consciousness (Hawkins, 2004; Byrnes, 2001; Seung, 2012). If you teach factoring through connections to zeros of polynomial functions, mentioning or using one will likely bring the other to consciousness. If, when making the connection between zeros and factors, if you use the zeros of the I.V. drip model you have further enriched the associations increasing the chances of correct recall. (Beversdorf, 2003; Schacter, 2001; Thompson & Madigan, 2005). That is, upon the need to recall: "If one circuit fails to function, the other is likely to work" (Edelman, 2006, p. 33).

Memory through Practice

Memory through memorization is especially bad with regards to recall over time (Langer, 1997; Feynman, 1985). It requires processing by our working memory. "It seems that a student actually can carry items for up to several weeks in working memory and then discard them when they serve no further purpose—in other words, after the student takes the test" (Sousa, 2010, p. 18). Working memory is typically activated through practice. Intentionally storing algebra content in working memory is not good for students for two reasons: one is that working memory requires constant review (or repetition) to maintain the quality and recall, and two, working memory is commonly purged when the content is no longer of value to the brain (like after a midterm or other test). An athlete or musician uses practice to memorize a move or a movement. When practice subsides, the athletic move becomes rusty and the musical movement contains different notes or may be missing notes that were in the original memory (Lynch & Granger, 2008). Imagine the consequences to an algebra student when they miss some procedural steps while answering a question on a test.

On the other hand, just like using neural associations at the beginning of a lesson, the use of visualizations near the beginning of a lesson will improve long-term memory and enhance understanding of the concept or procedure in the lesson (Pinker, 1997; Buonomano, 2011). Using a visualization to confirm pencil-and-paper work or teaching an application of the math already taught does not yield the same results for memory or understanding (Schacter, 2001). Another reason for using daily connections is that memory developed through the auto-associative memory system can be retrieved correctly even though you start with an incomplete version of it (Hawkins, 2004).

Another important benefit of using contextual situations to create neural associations is that the "…

emotional stakes enable us all to understand certain concepts more quickly" (Greenspan & Shanker, 2004, p. 241). Greenspan and Shanker described teaching the concept of a tax as a portion of the whole while using pizza as their emotional stake; they also describe using candy to teach addition. The point is that the "emotional" context can be a simple real-world context that has meaning to students, like an I.V. drip. You also find that the use of neural associations provides a tool for mathematical understanding as indicated by Restak (2006), "We understand something new by relating [connecting] it to something we've known or experienced in the past" (p.164). The common practice of "explaining" does not provide the same level of understanding if explaining references no real-world context or makes no connections to a common theme or to previously learned mathematics.

Final Observations

The bottom line is that learning changes brain circuitry. Research from the neuroscience community is very clear; neural associations are the primary method by which the brain stores and retrieves long-term memories. While neural science research is ongoing, the implications of core brain functioning of neural associations and pattern generalizing will likely only be refined in future years.

In the popular topics-based algebra curriculum, you may miss the opportunity to connect algebraic concepts or processes so that students can more likely recall and understand algebra. The brain needs to strengthen individual associations through repeated exposure to them in a variety of ways. For example, the I.V. drip can be used to make connections to variable, function, function representation, rate of change, initial condition, slope-intercept form, increasing, decreasing, equations, and zeros of functions. As the single common link contextual situation, it has the power to affect recall and understanding of considerable algebra. However more importantly, any of the connected algebraic concepts can now trigger the recall of any other connected concepts.

If you think of the algebra curriculum as a series of "topics," and you develop activities for teaching each topic, you may disregard connections, simultaneity, early use of visualizations, contextual situations, pattern building, etc., thereby not capitalizing on core brain function. Teaching algebra as a series of topics suggests that the brain deals with this situation by memorizing concepts and processes using working memory. Working memory is not designed to act as long-term memory and is often purged after a midterm exam (Sousa, 2010). Langer (1997) agrees: "Memorization appears to be inefficient for long-term retention of information and it is usually undertaken for the purposes of evaluation by others" (p. 72).

An algebra curriculum based on a common theme of function representation and function behaviors, solves the isolated topics problem. Under this structure, nearly all algebraic concepts and procedures become directly connected – depending on the sequential order of the concepts being taught, the use of a graphing calculator (for processing function representation, pattern building, and analyzing function behaviors), and integration of simple contextual situations.

NOTE:

The references used in this manuscript are mostly of the work from neuroscientists. Richard Feynman who is a Nobel Laureate in physics. Gerald Edelman is a Nobel Laureate in medicine. James Byrnes, P. Mark Taylor, Darris Brock, and David Sousa are educators. Sharon Begley and Terry McDermott are science writers.

REFERENCES

Begley, S. (2007). *Train your mind, change your brain: How a new science reveals our extraordinary potential to transform ourselves.* New York, NY: Ballantine Books.

Bergen, B. K. (2012). *Louder than words.* New York, NY: Basic Books.

Beversdorf, D. (2003). Division of Cognitive Neurology at The Ohio State University Medical Center, personal email

Bjork, R. (2012). Applying cognitive psychology to enhance educational practice. UCLA Department of Psychology. Accessed 4/10/2013: http://bjorklab.psych.ucla.edu/research.html

Buonomano, D. (2011). Brain bugs: How the brain's flaws shape our lives. New York, NY: W. W. Norton & Company.

Byrnes, J. P. (2001). *Minds, brains, and learning: Understanding the psychological and educational relevance of neuroscientific research.* New York, NY: The Guilford Press.

Eagleman, D. M. (2011). *Incognito: The secret lives of the brain*. New York, NY: Pantheon Press.

Edelman, G. M. (2006). *Second nature: Brain science and human knowledge.* New Haven, CT: Yale University Press.

Feynman, R. P. (1985). *Surely you're joking Mr. Feynman!: Adventures of a curious character.* New York, NY: W. W. Norton & Company.

Greenspan, S. I., & Shanker, S. G. (2004). *The first idea: How symbols, language, and intelligence evolved from our primate ancestors to modern humans.* Cambridge, MA: Da Capo Press.

Hawkins, J. (2004). *On intelligence.* New York, NY: Times Books.

Langer, E. J. (1997). *The power of mindful learning.* Cambridge, MA: Perseus Publishing.

Laughbaum, E. D. (2011). Capitalizing on Basic Brain Processes in Developmental Algebra-Part Three. *MathAMATYC Educator*, 3 (1), pp. 10-13.

Lynch, G., & Granger, R. (2008). *Big brain: The origins and nature of human intelligence.* New York, NY: Palgrave MacMillan.

McDermott, T. (2010). *101 theory drive: A neurologist's quest for memory.* New York, NY: Pantheon Books.

Pinker, S. (1997). *How the mind works.* New York, NY: W. W. Norton & Company.

Restak, R. (2006). *The naked brain.* New York, NY: Three Rivers Press.

Schacter, D. L. 2001. *The seven sins of memory: How the mind forgets and remembers.* Boston, MA: Houghton Mifflin Company.

Seung, S. (2012). *Connectome: How the brain's wiring makes us who we are.* New York, NY. Houghton Mifflin Harcourt.

Sousa, D. A. 2010. How science met pedagogy. *Mind, brain, & education: Neuroscience implications for the classroom,* D. A. Sousa (Ed.), pp. 9-24. Bloomington, IN: Solution Tree Press.

Taylor, P. M. & Brock, D. J. (2008). *Fast food education: Calling for a more natural approach to teaching & learning in America.* Knoxville, TN: Koinonia Associates.

Thompson, R. F., & Madigan, S. A. (2005). *Memory.* Washington, D.C: Joseph Henry Press.

Edward D. Laughbaum • *Emeritus Mathematics Professor*
• *<elaughba@math.ohio-state.edu>*

$\log_5 (625) = L$

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 $1,200 to $24,000 and can be used for conferences, workshops, seminars; research and in-service training in mathematics coursework; or professional development activities. MET is currently accepting applications for its summer cycle of grants and scholarships for current and future math teachers. The deadline is November 8, 2013.

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,

<http://www.nctm.org/resources/content.aspx?id=198>

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

Legislative Update and Advocacy

Texas Legislature

Many bills were passed in the 2013 regular session of the Texas Legislature. To see a comprehensive list of those that have been passed, signed or vetoed, go to *<www.tea.state.tx.us/index4_wide.aspx?id=25769805205>*.

Following our excerpts from the Texas Education News Release of June 12, 2013 on HB 5 (see *<www.tea.state.tx.us/news_release.aspx?id=25769805495>*

> Under House Bill 5 (HB 5), passed by the 83rd Texas Legislature and signed by the governor, high school students are now required to pass five State of Texas Assessments of Academic Readiness (STAAR®) end-of-course exams to meet the new graduation requirements.
>
> The five assessments under HB 5 include Algebra I, English I (combined reading/writing), English II (combined reading/writing), biology, and U.S. history. The Texas Education Agency will be advising school districts and charters that students must pass all five of these end-of-course assessments to be eligible to graduate from a Texas public high school.
>
> As a result, students who have taken a required assessment - but have not yet passed - will still need to demonstrate satisfactory performance on that exam to meet the state's graduation requirements.
>
> Assessments in Algebra II, geometry, English III, chemistry, physics, world geography, and world history have been eliminated from the testing requirements. As a result, the July 2013 STAAR administration will not include assessments for these courses. End-of-course assessments will continue to be offered in Algebra I, English I, English II, biology, and U.S. history.
>
> HB 5 also eliminates the 15 percent grading requirement. The STAAR end-of-course cumulative score component has also been eliminated.

CSCOPE

Quoting from the Texas Tribune *<www.texastribune.org/2013/05/20/cscope-will-no-longer-offer-lesson-texas-schools/>*

> On Monday [May 20, 2013], [Representative Dan] Patrick said that as a result of an agreement ..., representatives of the state-funded coalition of education service centers that oversees CSCOPE would notify the 875 school districts using the system that it would no longer offer lesson plans or produce them in the future. CSCOPE, he said, would return to the "original business plan of providing a management tool for teachers to stay on schedule" teaching the required state curriculum.

State Board of Education (SBOE)

You may contact any SBOE member with this email <sboesupport@tea.state.tx.us>. Be sure to identify your SBOE member. SBOE actions for 2013 will include review of K-8 mathematics instructional materials for Proclamation 2014 (final SBOE approval in November 2013, with goal of classroom implementation in August 2014).

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

Recommended App

Math Evolve Lite (Free) and
Math Evolve ($1.99)

by Zephr Games

This app provides students with an opportunity to practice basic math facts for addition, subtraction, multiplication and division. Using a gaming format, students select the numbers to be used and gain points when they choose the correct solution. The app provides different gaming environments (outer space, ocean, and microscopic) with some shooting included. This might be a great way to engage students in practice.

Don't forget to check out other free online resources created by NCTM on the Illuminations website. Go to:

<illuminations.nctm.org/>.

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

$10! = F$

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, Martha Godwin. 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 2012-13 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		

The University of Texas at Austin
Texas Mathematics Teacher
Charles A. Dana Center
1616 Guadalupe, Suite 3.206
Austin, TX 78701

Mark your calendar for these important dates!		
Panhandle Area Mathematics and Science Conference	West Texas A & M University, Amarillo, TX	***September 28, 2013***
Austin Area CTM	Westview Middle School, Pflugerville ISD	***October 26, 2013***
Rio Grande Valley CTM	University of Texas – Pan American, Edinburg, TX	***November 9, 2013***
7th Annual Texas STEM Conference	Dallas, TX	***February 6-8, 2014***
Central Texas CTM	ESC 12, Waco, TX	***February, 2014***
NCTM 2014 Annual Meeting and Exposition	New Orleans, LA	***April 9–12, 2014***
CAMT 2014	Fort Worth Convention Center	***July 21-23, 2014***