The Centroid

The Journal of the North Carolina Council of Teachers of Mathematics

In this issue:

Volume 45, Issue 1 • Fall 2019

The Centroid is the official journal of the North Carolina Council of Teachers of Mathematics (NCCTM). Its aim is to provide information and ideas for teachers of mathematics—pre-kindergarten through college levels. *The Centroid* is published each year with issues in Fall and Spring.

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Submission of News and Announcements
We invite the submission of news and announcements of interest to school mathematics teachers or mathematics teacher educators. For inclusion in the Fall issue, submit by August 1. For inclusion in the Spring issue, submit by January 1.

Submission of Manuscripts
We invite submission of articles useful to school mathematics teachers or mathematics teacher educators. In particular, K-12 teachers are encouraged to submit articles describing teaching mathematical content in innovative ways. Articles may be submitted at any time; date of publication will depend on the length of time needed for peer review.

General articles and teacher activities are welcome, as are the following special categories of articles:

- *A Teacher's Story*,
- *History Corner*,
- *Teaching with Technology,*
- *It's Elementary!*
- *Math in the Middle*, and
- *Algebra for Everyone*.

Guidelines for Authors
Articles that have not been published before and are not under review elsewhere may be submitted at any time to Dr. Debbie Crocker, CrockerDA@appstate.edu. Persons who do not have access to email for submission should contact Dr. Crocker for further instructions at the Department of Mathematics at Appalachian State, 828-262-3050.

Submit one electronic copy via e-mail attachment in *Microsoft Word* or rich text file format. To allow for blind review, the author's name and contact information should appear *only* on a separate title page.

Formatting Requirements

- Manuscripts should be double-spaced with one-inch margins and should not exceed 10 pages.
- Tables, figures, and other pictures should be included in the document in line with the text (not as floating objects).
- Photos are acceptable and should be minimum 300 dpi tiff, png, or jpg files emailed to the editor. Proof of the photographer's permission is required. For photos of students, parent or guardian permission is required.
- Manuscripts should follow APA style guidelines from the most recent edition of the *Publication Manual of the American Psychological Association*.
- All sources should be cited and references should be listed in alphabetical order in a section entitled "References" at the end of the article following APA style. Examples:

  Books and reports:

  Bruner, J. S. (1977). *The process of education* (2nd ed.). Cambridge, MA: Harvard University Press.

  National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

  Journal articles:

  Perry, B. K. (2000). Patterns for giving change and using mental mathematics. *Teaching Children Mathematics*, *7*, 196–199.

  Chapters or sections of books:

  Ron, P. (1998). My family taught me this way. In L. J. Morrow & M. J. Kenney (Eds.), *The teaching and learning of algorithms in school mathematics: 1998 yearbook* (pp. 115–119). Reston, VA: National Council of Teachers of Mathematics.

  Websites:

  North Carolina Department of Public Instruction. (1999). *North Carolina standard course of study: Mathematics, grade 3.* Retrieved from http://www.ncpublicschools.org/curriculum/mathematics/grade_3.html

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About the Cover
The image on the cover depicts the centroid of a triangle.

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NCCTM State Math Conference and Fall Leadership Seminar

November 6, 7, 8, 2019
Koury Convention Center, Greensboro, NC

Developing Mathematical Mindsets for All

Register online at: https://www.ncctm.org/conferences/state-mathematics-conference/

Book a hotel room at the conference rate through October 6 at:
https://book.passkey.com/event/49867416/owner/2511/landing

For more information go to

https://www.ncctm.org/

President's Message

State President Kathy Jaqua
Western Carolina University, Cullowhee NC
kjaqua@email.wcu.edu

We Have a Super Power—We Teach Children Mathematics!

As teachers, our power starts with our commitment to children and moves into the classroom where every day we have a direct impact on students' learning of mathematics, and through them on all of North Carolina. Our power grows through interactions with other teachers, administrators, and parents. When we pool all of our powers, we become a Super Power. Here is a short quiz about five ways that NCCTM can help you access your Super Power to have an even greater impact on mathematics teaching and learning in our state.

#1: Do you have a lesson that works well in your classroom? The answer is YES! You have lots of great activities, lessons, and ideas that you use in your classroom successfully. Share those ideas with other teachers through presentations at three Regional NCCTM meetings every spring or at the State meeting each fall. Write about one of your great teaching ideas and submit it to the CENTROID so that others can benefit from your success in the classroom. However you do it, share your great ideas.

#2: Do you have an idea for a great new lesson, but you need some materials to make it work? The answer is YES! Members can apply for a mini-grant from NCCTM and bring that lesson into the classroom. Your students can benefit directly, and you have a way to enhance your classroom tools and materials. Dream big, and get classroom resources to help you achieve that dream.

#3: Do you want something mathematical and fun to fill in those last few minutes some days? The answer is YES! Get your students involved in the Math Fair sponsored by NCCTM. Having students work on Math Fair projects individually or in pairs over a semester encourages students to do mathematics and can enhance their ability to talk about mathematics with others, including parents. Get students actively involved in exploring mathematics.

#4: Do you want to help your middle grades and secondary students hone their mathematics skills? The answer is YES! Join with other teachers and parents to give your students the chance to compete in the Regional and State Math Contests sponsored by NCCTM and in the American Mathematics Competitions sponsored by the Mathematical Association of America. Friendly competition can encourage some students to work hard to master math skills.

#5: Are you interested in or already enrolled a graduate program? Only you know this answer. But, if your answer is YES!, then NCCTM has a scholarship that can help members pay for some of that graduate work. You are spending time and money to enhance your knowledge and skills, and NCCTM can help.

Joining with more than 1500 members of NCCTM gives us the collective knowledge, skills, and ideas to improve mathematics teaching and learning for all children in North Carolina. Whether you are looking for new ideas, new activities, new resources, or new connections, NCCTM is poised to help you tap into that Super Power.

Modeling Bridges with Quadratic Equations

Solomon L. Willis, Cleveland Community College, Shelby, NC

The author presents a lesson that uses images of bridges to build parabolic models of the structures, including step-by-step calculator instructions for working with the image to fit a quadratic on a TI 84.

In the lesson detailed in this article, students view a presentation of 10 famous bridges and then engage in some activities that incorporate a few geometric ideas related to the design of bridges that contain some type of parabolic arch. The lesson plan is intended for a high-school class covering Geometry and/or Algebra II; however, it may also be used at the college level in a Quantitative Literacy class and/or a Pre-Calculus class.

A quadratic equation is modeled by $f(x) = ax^2 + bx + c$, and the algebraic concept of finding the axis of symmetry can be compared to finding a line of symmetry in a geometric shape, such as the area underneath a bridge that exists from the parabolic arch to the ground (or water) level. A graph, or a shape, is symmetric with respect to the line of symmetry if a mirror reflection exists along the line (Smith, 2016, p. 331). In many cases, students enrolled in a class that is introducing geometric concepts and/or connecting geometric concepts to algebraic concepts, will also be taking pre-calculus and calculus classes later on. It is never too early to introduce the idea of rotational symmetry. In rotational symmetry, if the figure is rotated about the line of symmetry in a complete 360-degree rotation, the image will be exactly the same as the original figure (Dossey, McCrone, Giordano, & Weir, 2002, p. 222).

Area problems involving squares, rectangles, and/or circles, are usually very easy. However, once a curve is involved, a working knowledge of calculus is often required to find such computations. Integrals can help solve area problems, and those computations can be found by considering a series of areas of inscribed polygons (Smith, 2016, p. 878). Often, approximations are made by partitioning the area into smaller rectangles and/or trapezoids. However, for our specific lesson at hand, a simpler formula will be used. The surface area that exists underneath the arch of the parabola and the ground (or water) can be found by the following formula (Simmons, 2017). We will use this formula within our lesson plan to compute the areas underneath the arch of some of the bridges.

$$Area = \frac{2}{3}(width)(height)$$

Distance is another important geometric concept that can be easily included in our lesson with bridges. For the most part, we will only be looking at distances for straight, vertical, and/or horizontal line segments, given by the formula: $D = |a - b|$, where point a and point b are the endpoints of the line segment (Hoffer et al., 1998, p. 41). When working on a coordinate plane, however, the algebraic version of the distance formula is generally used:

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Using bridges to help illustrate symmetry, area, distance, and quadratic equations, the lesson that follows should be very engaging to students and hopefully enhance these topics to be something meaningful and

memorable. When students can see how math is used in the real world, they tend to develop a deeper understanding and appreciation of the concepts.

The Lesson Plan

This lesson addresses the objectives from the *NCTM Principles and Standards for School Mathematics* (NCTM, 2000) listed in Table 1. Specific student learning objectives:

- Model the arch underneath (or on) a bridge with a quadratic equation.
- Find the vertex of the quadratic equation.
- (Approximately) find the distance from the vertex to the ground level of the bridge.
- Find the axis of symmetry and discuss the symmetry of the graph.

Table 1. NCTM standards and expectations addressed.

Standard	*Grades 9-12 Expectations*
Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.	• Analyze properties and determine attributes of two- and three-dimensional objects. • Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them.
Specify locations and describe spatial relationships using coordinate geometry and other representational systems.	• Investigate conjectures and solve problems involving two- and three-dimensional objects represented with Cartesian coordinates.
Use visualization, spatial reasoning, and geometric modeling to solve problems.	• Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools. • Use vertex-edge graphs to model and solve problems. • Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest such as art and architecture.

Procedure: The teacher will present a slideshow with photos of the 10 bridges that will be used in the lesson. Next, the teacher will illustrate, using one of the 10 photos, how to load it into the TI-84 C Graphing Calculator and adjust the window settings so that the bottom left edge of the bridge is as close to the origin as possible. In addition to a TI-84 Plus CE Calculator, the following will be needed:

- Computer
- TI-Connect software installed
- TI-Connectivity cable
- Image file in JPEG format

Step by-step Calculator and Computation Directions: These instructions are adapted from *Next Steps With the TI-84 Plus CE* (Texas Instruments, 2018). They are illustrated with an image of a bridge in a Chinese Asian Garden Park (retrieved from needpix.com).

(1) TI-84 Plus CE Instructions for Loading Picture(s) into Calculator Using the TI-Connect to Drag and Drop
   a. Start the TI-Connect software on your computer
   b. Connect the calculator to the computer with the TI-Connectivity cable
   c. Click on TI Device Explorer on TI Connect to open the Device Explorer window
   d. Drag the digital image into the Device Explorer Window
   e. You will be prompted for an image name
   f. Click OK when done

Note: Images can also be transferred from calculator to calculator.

(2) TI-84 Plus CE Instructions for Plotting Points and Finding Regression Equation: The *quick-plot* and *fit-eq* APPs will then be used to drop points along the parabolic shape that is on or underneath the bridge, and then a quadratic regression equation will be found.

a. Press 2nd, Format, to access the Graph Format menu.
b. Press the down arrow key to reach Background.
c. Press the left or right arrow keys to view the options. Image variables are shown, followed by choices for solid color backgrounds.
d. Once you have made your selection, press the up or down arrow key.
e. Press Window to enter the values shown in Figure 1.
f. Press Graph to see the background and axes displayed.
g. Press Stat.
h. Press the right arrow to reach the Calc menu.
i. Scroll down to E:QuickPlot&Fit-EQ, press Enter.
j. Press the Style soft key. Use the left and right arrow keys to change the color of the drop points and the equation. You may also change the line style.
k. Highlight OK, and then press Enter.
l. Move the cursor near the origin, and press enter to drop the first point.
m. Continue moving the cursor and dropping points on the graph to form a parabolic shape overtop the bridge (Fig. 2). If you make an error, press 2nd, Quit. To clear the screen, press 2nd, Draw, 1:ClrDraw, then Enter.
n. When you have dropped the desired number of points, press the FITEQ soft key.
o. Select the regression model 3:QuadReg.
p. The equation of the regression model, $y = ax^2 + bx + c$, is displayed and graphed (Fig. 3). Follow the prompts to store the data in L1 and L2 and the equation into Y1.

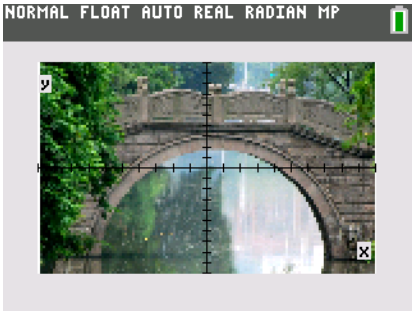

Figure 1: Importing and setting the window on the TI 84.

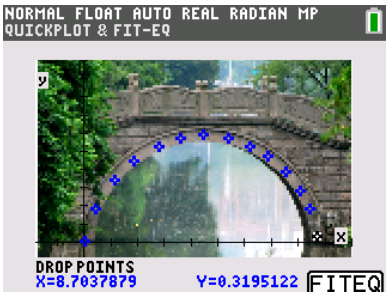

Figure 2: Dropping points on the TI 84.

(3) The vertex (or maximum) of the arch underneath the bridge will be found (analytically) using the fitted equation:

$$f(x) = -0.286x^2 + 2.554x + 0.471$$

x-coordinate:

$$x = \frac{-b}{2a} = \frac{-2.554}{2(-0.286)} \approx 4.465$$

y-coordinate:

$$f(4.465) = -0.286(4.465)^2 + 2.554(4.465) + 0.471 = 6.173$$

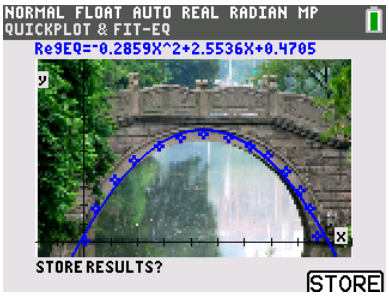

Figure 3: The fitted quadratic on the TI 84.

From these calculations:

- Maximum coordinate point of the parabola: (4.465, 6.173)
- Lowest point at water (or ground) level that is directly underneath the maximum: (4.465, 0)
- Distance to the water surface (or ground): 6.173 units, which can also be calculated using the distance formula:

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$D = \sqrt{(4.465 - 4.465)^2 + (0 - 6.173)^2}$$
$$D = \sqrt{(-6.173)^2}$$
$$D = 6.173 \text{ units}$$

For simplicity, we will use the generic "units" notation since we are unsure of the scale of the photo. The axis of symmetry will be defined, and the symmetry of the graph will also be discussed. Note: Finding the axis of symmetry is the same procedure as finding the x-coordinate of the maximum value.

$$x = \frac{-b}{2a} = \frac{-2.554}{2(-0.286)} \approx 4.465$$

The axis of symmetry, as its name suggests, divides the area underneath the arch in half. There is symmetry along each side of this vertical line. Rotational symmetry also exists along the axis of symmetry, and if the bridge were completely rotated along this line, the "new" image would retain the same shape as the original.
The surface area that exists underneath the arch of the parabola and the ground (or water) can be found by the formula in Figure 4.

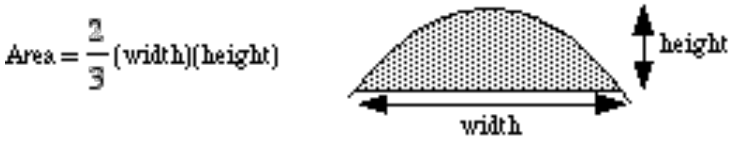

Figure 4. The formula for the area under a parabolic arch. (Simmons, 2017).

The height is 6.173 units (from the distance computation above), and the width is roughly twice the amount of the x-coordinate: 2(4.465) = 8.930. We will assume this idea because the graph was positioned as closely to the x-axis as possible (for simplicity). The surface area underneath the arch is approximately:

$$Area = \frac{2}{3}(width)(height)$$
$$Area \approx \frac{2}{3}(8.930)(6.173) \approx 36.750 \text{ units}^2$$

After the direct instruction, and after the teacher has explained all of the procedures, students will work in groups to find the solutions for each of the remaining photos. The teacher will provide the photo through the T.I.-Navigator system and/or by direct download. For each bridge, students should find:

- Points along the parabolic arch
- A quadratic regression equation to model the arch
- The axis of symmetry and the vertex of the parabola
- The distance from the maximum point from the parabola to ground-level
- The area underneath the arch

Groups will be observed by the teacher for the remainder of the lesson. To conclude the lesson (possibly the next day), each group will present their solutions for one of the other 9 bridges to the rest of the class. Students will be assessed in groups based on teacher observations, their collaboration within their group, their written solutions to the given problems, and their class presentations.

Summary of Students' (Anticipated) Reactions/Evaluations
This lesson sparks the interest of students, in seeing how parabolas model the arches underneath the bridges. This lesson makes the material more engaging and also shows students how this type of mathematics can be used in the real world. Students seem to enjoy working in groups and reminding each other how to do things (as needed). The PowerPoint presentation, direct instruction, and class discussion of the various concepts help students retain the

material. It can sometimes be easy for students to make a few computational errors along the way, but when they do, teachers can step in and help make corrections as needed. With so many decimal numbers involved, there is room for error! Overall, however, each group can demonstrate comprehension of these geometric topics and can see how they relate to algebra, upon completion of the lesson.

Evaluation of Lesson

I believe this lesson is a "fun" lesson to use with my students because it keeps them engaged throughout the entire process. When a task or activity truly engages students, it has the effect of consuming their minds during a class period. It is truly remarkable what students can achieve if we have their undivided attention.

I use this lesson as a follow-up to studying parabolas, quadratic equations, and their properties. In a "perfect-world," we would always use whole number coordinates, but when modelling real-world situations, it is not always possible. At the community college level, I use this lesson near the end of my Quantitative Literacy class, in a unit in geometry. I also use the lesson in my Pre-Calculus class. In both, my hope is that by the end of the lesson, a complete or better mastery of quadratic equations, symmetry, and surface area is obtained and/or maintained.

Bridge Images

Here are links to bridges that could be used to create a presentation for this lesson. Images that are a direct view (i.e., the bridge is perpendicular to the line of sight) work best for estimating heights.

- https://www.needpix.com/photo/1521678/bridge-arch-arched-chinese-asian-garden-park-tranquil
- https://www.reviewjournal.com/traffic/hoover-dam-bypass-bridge-inspection-will-prompt-lane-restrictions-sidewalk-closures/
- https://thislittlelight1965.wordpress.com/tag/selma-mayors-youth-council/
- https://www.flickr.com/photos/72131699@N00/2705286066
- https://www.britannica.com/place/Newcastle-upon-Tyne-England
- https://www.mackinacbridge.org/history/the-mighty-mac/
- https://en.wikipedia.org/wiki/Golden_Gate_Bridge
- http://www.highestbridges.com/wiki/index.php%3Ftitle%3DGarabit_Viaduct
- http://www.genkin.org/cgi-bin/photo.pl/australia/sydney/hb/au-sydney-harbour-bridge-0038
- https://bosniahistory.wordpress.com/2013/06/15/stari-most-old-bridge-1566-to-today/
- http://www.shropshire-guide.co.uk/places/the-iron-bridge-tollhouse/

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Texas Instruments, Inc. (2018). *Next steps with the TI-84 Plus CE graphing calculator in high school mathematics.* Dallas, TX: Texas Instruments Incorporated.

2019 State Math Fair Winners

Reported by Betty Long, Appalachian State University, Boone, NC

NCCTM sponsors three regional Math Fairs each spring, and the best projects presented at these regional Fairs qualify for the State Math Fair. This year's State Fair was held at the North Carolina School of Science and Mathematics on May 3. The following students were selected for top honors in each division.

Primary Division, Grades K-2

1st Place: Brigsley Wozny, "*Rainbow Ratios*," Woodland Heights Elementary School, Mooresville, NC
2nd Place: David Rose, "*Magical Math*," Poplar Springs Elementary School, King, NC
3rd Place: Taylor Finger & Madeline Gerlip, "*It's Cookie Time*," Woodland Heights Elementary School, Mooresville, NC
Honorable Mentions:

Ema Garcia "*Math: It's Virtually Everywhere!*" West Greene Elementary School, Snow Hill, NC
Nicholas Pieroni, "*Different Numbering Systems*," Glenwood Elementary School Chapel Hill, NC

Elementary Division, Grades 3-4

1st Place: Aubrey Johnson, "*Mathnado*," Frederick Douglass Elementary School, Wilson, NC
2nd Place: Loulie Harrison & Della Ruth Koster, "*Phoney Business*," Frederick Douglass Elementary School, Wilson, NC
3rd Place: Grace Young, "*Can You be Penny Wise?*" Parkway Elementary School, Boone, NC
Honorable Mentions:

Angus Despeaux, "*Martian Math*," Cullowhee Valley School, Cullowhee, NC
Tyler Carpenter & Grady Wilson, "*How Many Nerf Bullets Fit in Our Rooms?*" Woodland Heights Elementary School, Mooresville, NC
Taytum Robbins, "*TBR Entertainment*," Mountain View Elementary School, Hickory, NC

Intermediate Division, Grades 5-6

1st Place: Cooper Beecham, "*Spotlight on Me!*" Coddle Creek Elementary School, Mooresville, NC
2nd Place: Abby Cho, "*Predicting the Ozone Layer's Future*," Immaculata Catholic School, Durham, NC
3rd Place: Ta'Mar Shrewsbury & Ragan Burge, "*DIY vs. Salon Nails*," Poplar Springs Elementary School, King, NC
Honorable Mentions:

Morgan Davis, "*Roller Coaster Math*," Greene County Intermediate School, Snow Hill, NC
Olivia Stewart, "*Math + Baking = A Recipe to Pass On!*" Cool Spring Elementary School, Cleveland, NC
Akela Taylor, "*Math Movers*," Pleasant Ridge Elementary School, Gastonia, NC

Middle School Division, Grades 7-8

1st Place: Thomas Brann, "*Measure Up!*" Hope Middle School, Greenville, NC
2nd Place: Ava Herring & Gurmeher Kaur, "*Mathematical and Origami Spirals*," McDougle Middle School, Chapel Hill, NC
3rd Place: Leah Wainwright, "*Can You Use Hand Size to Predict Height?*" Hope Middle School, Greenville, NC
Honorable Mentions:

Will Kelley & Jackson Greene, "*How Wide is That?*" South Asheboro Middle School and Faith Christian School, Asheboro, NC
Eden Ragsdale & Tulsi Asokan, "*Pythagorean Theorem Sand Demo*," McDougle Middle School, Chapel Hill, NC
Maya Vizuete, "*Multiplying Force in Hydraulic Machines*," McDougle Middle School, Chapel Hill, NC
Sydney Lin, "*Making Music With a Mobius Strip*," McDougle Middle School, Chapel Hill, NC

High School Division, Grades 9-12

1st Place: Akshar Patel, "*Ahead of the Hurricane, Part 2*," Northwest Cabarrus High School, Concord, NC
2nd Place: Nathan Brown, "*Deriving the Perimeter of Horizontally and Vertically Stretched Regular Shapes*," South Point High School, Belmont, NC
3rd Place: Valerie Kitchell, "*Mind the Efficiency Gap: Exploring Voter Waste as a Signal of Partisan Gerrymandering in North Carolina*," Watauga High School, Boone, NC
Honorable Mention:

Shy'Mir D., "*Basketball Analytics Per in the NBA*," Stonewall Jackson Youth Development Center, Concord, NC

Connecting Mathematicians to Middle School Students with Literature

Faye Bruun, Texas A&M University, Corpus Christi, TX

The author discusses the advantages of integrating literature into mathematics classes, and provides a number of examples of specific age appropriate books that use or discuss math concepts.

It's the first day of middle school math class and I bring out a book entitled *Math Curse*. This is not going to be the usual math class, my students think! Middle school students may roll their eyes at the thought of their teacher reading a picture book to them, but most enjoy the activity and I find them looking at the book later during their free time.

Integrating literature with mathematics allows students to observe the connection between mathematics and our everyday world. This connection gives meaning to mathematics and makes it come alive. An overarching goal of the National Council of Teachers of Mathematics (NCTM) standards is the integration of mathematics contexts giving practical meaning to math symbols and processes. The *Principles and Standards for School Mathematics* (NCTM, 2000) considers curriculum connections so important in teaching mathematics that "Connections" is named and described as a separate process standard. These connections must not be contrived but authentic. Instead of thinking about mathematics as being discrete bits of information to be memorized and retrieved with no understanding, connections should help children learn to think about mathematical ideas as ways of expressing relationships. The NCTM Communication Standard states, "Students who have opportunities, encouragement, and support for speaking, writing, reading, and listening in mathematics classes reap dual benefits: They communicate to learn mathematics, and they learn to communicate mathematically" (p.60). This standard also states students learn through collaboration, discourse, and reading and writing in mathematics, or mathematical literacy. The monograph *Principles to Actions: Ensuring Mathematical Success for All* (NCTM, 2014) follows up this recommendation by stating "students develop connections among areas of mathematical study and between mathematics and the real world" (p. 5). Reading children's literature aloud helps promote the mathematics-literature connection and increases student engagement.

Wallace and Clark (2008) recommend using children's literature to integrate literacy instruction with mathematics and other subjects because of its ability to not only "spark excitement, but also to provide a context for learning, to introduce vocabulary and other abstract concepts, and to show how mathematics can be linked to other content areas" (p. 71). This "reading mathematics" is based on the social-constructivist theory of learning, which values multiple constructions of meaning as well as the process of construction, realizing the learning brings unique experiences to the lesson in order to create meaning (Bruner, 1961; Vygotsky, 1978/1934). Teachers help students make real world connections with literature in mathematics by scaffolding the learning experience (Vygotsky, 1978/1934). "Reading mathematics" includes reading multiple texts as a way to supplement the textbook. Placing mathematics in a real-world context, children can learn "real world mathematics problems can be 'messy' and have multiple solutions, and are not typically static, like those frequently seen in their textbooks" (Moyer, 2000, p. 248).

Integrating literature into mathematics will help promote mathematical literacy. Using children's literature to enrich learning in content areas such as mathematics provides opportunities for students to make text-to-self connections between subject areas and real life (Whitin, 2002). The notion of connecting learning within multiple disciplines is not new. Almost 100 years ago John Dewey (1938/1997) proposed that integrating the curriculum for students would not only make learning more relevant but also more interesting. Experience is always the priority of students' strategy choice in solving a problem; unfortunately, it is so often ignored in school education. Dewey's ideas reflect contemporary significance for a number of reasons. The demands and dynamics of a 21st century society dictate teachers prepare their students for real-life problem solving. Because the world is not neatly organized into separate categories, the classroom instruction students receive should not be segmented into disciplines taught in isolation from one another.

Picture Books in Middle Grades

Burns (2010) recommends using picture books for students who love to read "to experience the wonder of math in the same way they already enjoy the wonder of books. Plus, students whose first love is math will learn to look at books in new ways" (p.38). It can also help teachers who do not feel comfortable teaching mathematics by building on their strengths of teaching reading and language arts.

Middle school teachers can look beyond the recommended age group for which the book is recommended when searching for children's literature to use in teaching mathematics. They should consider how the book could add to the mathematics curriculum in the grade they are teaching. There are many books that engage students that teachers might not consider because they have been designated for certain ages or grade levels (Whitin, 2002). "We have found that picture books intended for primary grades can be used effectively in upper grades to extend mathematical concepts that are abstract to students" (Kinniburgh & Byrd, 2008, p.34).

Picture books can be used to teach a variety of subject areas including mathematics. The reasons given for using picture books in middle grades is for enjoyment, independent reading options, and a culturally diverse classroom. Abstract concepts in science, technology, engineering, and mathematics (STEM) can be given more concrete and visual connections to students' experiences by using the visual examples, models, and diagrams in a picture book on the topic being presented using fascinating drawings and simple explanations. Each page can be used as a whole-class, concept-related introduction to the topic, both to provide a simple visual foundation on which to build more abstract ideas, and to provide motivation for studying those ideas.

Picture books can make invaluable contributions to any middle-level classroom. They can be used specifically for academic purposes, and they can provide popular options for free reading. In a sense, all early adolescents begin their academic careers with early picture book experiences. It is entirely appropriate to continue to use this rich source of learning and enjoyment as long as the appeal remains. The act of reading a children's book aloud allows students to flashback to a time when teachers read aloud to them. Children's literature can help learners value mathematics, encourage learners to be mathematical problem solvers and provide a meaningful context for children to communicate mathematically (Shatzer, 2008).

STEM Literature books

The first book I ever used in a middle school mathematics classroom was given to me by my English Language Arts colleague. The book's name is *Math Curse* by Jon Scieszka (1995; rhymes with Fresca, lucky for him 'cause not much else does). The picture book, with illustrations by Lane Smith, tells a story of a girl who is in a math class taught by Mrs. Fibonacci. The pun is Fibonacci is the name of a famous mathematician known for discovering the Fibonacci sequence of numbers. In the picture book, everything becomes a math problem for the girl so she is sure Mrs. Fibonacci has put a math curse on her. The book is full of math problems that can be discussed and solved in class. I owned the book for many years before I realized the answers are all on the cover. My favorite problem is using how Mrs. Fibonacci counts, 1, 1, 2, 3, 5, 8, 13, 21, …. to demonstrate patterns. This is a great book to have students be creative and write their own math curse problems.

Once your school librarian knows you are interested in mathematics literature, they can help you. My librarian recommended the book *Blockhead: The Life of Fibonacci* (D'Agnese & O'Brien, 2010). The beautifully illustrated book is the story of how as a young boy, Fibonacci was called a blockhead because he was so curious

about the world around him, he seemed distracted all the time. He saw his sequence of numbers in nature in the town of Italy in which he lived. Besides the Fibonacci sequence, he is also credited with bringing the Arabic number system we use today to Europe where they were using Roman Numerals. Using my STEM literature website (Bruun, n.d.), you can find the book and a lesson plan outlining how to use the Fibonacci numbers to draw Fibonacci rectangles and shell spirals. The book can be also be integrated into Science class, since Fibonacci numbers are also found in nature. Both books are excellent examples of picture books about a famous mathematician and how mathematics can be found everywhere.

The next set of books I have used in mathematics class is the Sir Cumference series. The first one is *Sir Cumference and the Knights of the Round Table* (Neuschwander, 1997). The main characters of the series are introduced as Lady Diameter, wife of Sir Cumference, whose height is the length of one end of a circle to the other. They have a son named Radius, who is half his mother's height. Sir Cumference is the person who solved the problem in the book of using a round table for the knights to sit around. Forever more, the measurement around the outside of a round table or circle is named Circumference. The premise of the book is basic and can be paired with a lesson plan from my STEM Literature website where the students use different sized lids to measure the circumference, diameter, and radius.

The next book in the series is *Sir Cumference and the Dragon of Pi* (Neuschwander, 1999). Sir Cumference has been turned into a dragon and his son Radius must solve a riddle to save his father from staying a dragon forever. Radius discovers the relationship of circumference divided by diameter will always equal 3.14… or pi. Additional characters in the book are the carpenters named Geo-metry and Sym-metry who help Radius. The lesson plan given for this book is one in which the students roll different size cans on the floor and measure their rolling distance (circumference) and the diameter of the can, dividing the two measurements and "discovering" pi. The book ends with a statement that pie with an "e" will be for eating and Pi without the "e" will be for this special number for all things round. Archimedes is the mathematician who made this discovery and students can expand their knowledge by studying about him in the book *Archimedes: Mathematical Genius of Ancient Greece* (Gow, 2005). On my STEM Literature website, there is a lesson plan with a paper folding activity to use for reinforcing geometric vocabulary.

Sir Cumference and the Isle of Inmeter (Neuschwander, 2006), starts with the basics of perimeter and area of polygons and develops the concept of area of a circle by showing a slice of an orange and how by dividing it in half and placing the wedges together, a parallelogram can be formed. In my STEM Literature web site (Bruun, n.d.), under the concept of area of a circle, I have a lesson plan where students take paper plates and cut them into wedges like the orange. The parallelogram models:

Long side of rectangle = ½ circumference
Short side of rectangle = radius
Area of a circle = ½ circumference x radius
Area of a circle = ½ (2π r) x radius

"Students who can use the relationship between the shape of the 'parallelogram' and its area and the circumference of the circle to develop the formula for the area of the circle are demonstrating plausible and deductive reasoning" (NCTM, 1989, p. 221).

Sir Cumference and the Sword in the Cone (Neuschwander, 2003) once again uses the character of Radius to solve a riddle by figuring out the Rule of Two discovered by the Swiss Mathematician Leonard Euler (pronounced Oiler). In my STEM Literature website is a lesson plan and worksheet for recording the number of faces, vertices, and edges of various polyhedrons such as cubes, rectangular prisms, pyramids, to demonstrate Euler's Rule of Two: Faces plus Vertices minus Edges will always equal 2.

To continue with the theme of mathematicians, the next picture book I will cover is *What's Your Angle Pythagoras?* (Ellis, 2004). The ancient mathematician Pythagoras lived more than 200 years before Archimedes and proved the angles of a triangle add up to 180 degrees. The Pythagorean theorem states the relationship between the lengths of the sides of a right triangle. Activities on my STEM Literature website linked to this book include measuring a baseball field with 90 feet between each base and figuring out how far a player must throw the ball from home base to second base using the Pythagorean theorem. There are also activities for using a Clinometer and a trundle wheel to calculate the height of buildings.

Leonardo di Vinci is known as an artist but was a very talented mathematician. Studying him integrates art with mathematics. Jon Scieska, who wrote *Number Curse* (1995) mentioned at the beginning of this article, also wrote *The Time Warp Trio: Da Wild, Da Crazy, Di Vinci* (1996), and there is another picture book entitled *Who is Leonardo di Vinci?* (Edwards, 2005). Leonardo is famous for studying the proportions of the human body. Leonardo thought the "Ideal" man's height would equal his arm span as depicted in his famous picture entitled the Vitruvian man. The activity in the STEM Literature website has students measuring their height and arm span using metric sticks standing against the classroom wall. If the student's measurements are the same, then they are a "square." If their height is greater than their arm span, then they are a "tall rectangle." If their arm span is greater than their height, then they are a "wide rectangle." I made name tags for the students to wear that said "I am a square" cut into a square shape. I would orient the rectangular nametags to read "I am a tall rectangle," and "I am a wide rectangle" to wear after they measure themselves. Most students are not "square" as Leonardo predicted. There is a lesson plan more appropriate for middle school students using Leonardo's ratios:

- the arm span length is equal to a man's height
- the distance from the armpit to elbow "pit" is one-eighth of a man's height
- the distance from the tip of the hand to the elbow "pit" is one-fifth of a man's height
- the length of the hand is one-tenth of a man's height
- the length of the ear is one-third of the face

Students can then answer the question "What portion of you was 'ideal'?" There are other books about Leonardo di Vinci that may interest middle school students about art history by Diane Stanley (1996) and a mystery entitled *The Second Mrs. Giocanda*, (Konigsburg, 2005) about the Mona Lisa.

Conclusion

Picture books can be used in middle school mathematics and by using my website (Bruun, n.d.), you will find the books mentioned in this article along with the concept taught and a lesson plan to go along with the book. The website was developed from a graduate course entitled "Mathematics through Children's Literature" and lesson plans were developed by teachers and myself who used them in their classrooms. There are also books for grade bands K-2, as well as Science through Children's Literature.

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Trust Fund Scholarships: Now $1000

Scholarships are available from NCCTM to financially support North Carolina teachers who are enrolled in graduate degree programs to enhance mathematics instruction. Applicants must be:

- Currently employed as a pre-K-12 teacher in North Carolina;
- Currently an NCCTM member (for at least one year) at the time of submitting the application;
- Currently enrolled in an accredited graduate program in North Carolina;
- Seeking support for a mathematics or mathematics education course in which they are currently enrolled or have completed within the previous four months of the application deadline.

Applications will be reviewed biannually, and the deadlines for applications are March 1 and October 1. The application can be downloaded from the NCCTM website under the "grants & scholarships" link. The nomination form can be obtained from the grants and scholarships page on the NCCTM Website (ncctm.org). More information can be obtained from: Janice Richardson Plumblee, richards@elon.edu.

Donating to the NCCTM Trust Fund

Did you receive a Trust Fund Scholarship that helped you to complete your graduate coursework and you want to show appreciation? Do you wish to memorialize or honor someone important to you and your career as a math teacher?

Consider making a donation to the NCCTM Trust Fund, please send your donation, payable to Pershing LLC for the NCCTM Trust Fund, to:

Joette Midgett
North Carolina Council of Teachers of Mathematics
P. O. Box 33313
Raleigh, NC 27636

2019 NCCTM Logo Contest Winners

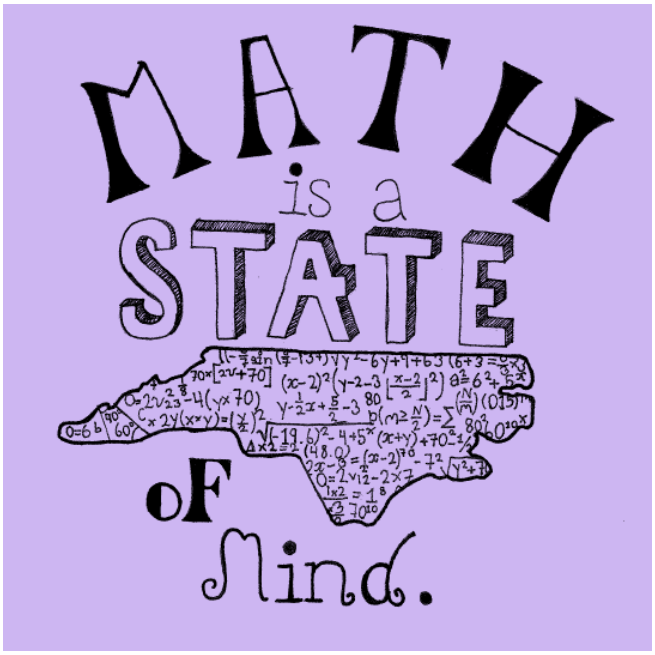
Reported by Anthony Finlen, Asheboro, NC

The Mathematics Logo Contest is held each spring. The NCCTM Board selects the winning logo at its Spring meeting. The 2019 winning logo, pictured, will be available on shirts at the NCCTM State meeting in October.

State Winner:

Avnielle Krause
6th Grade Student in Buncome County
Teacher: Brandi Fleckenstein

Other Finalists:



Eastern

Student - Grade - Teacher
Sydney Jones - 7th Grade - Jenks Johnson
Trenton Saunders - 9th Grade - Jenks Johnson
James Boone - 9th Grade - Jenks Johnson
Belle Turner - 7th Grade - Jenks Johnson

Western

Student - Grade - Teacher
Auerie Buckner - 6th Grade - Stacie Keitt
Sheldon Collier - 6th Grade - Stacie Keitt
Holly Grant - 12th Grade - Carmen Wilson
Rachel Richardson - 12th Grade - Carmen Wilson
Kiasia Carson - 9th Grade - Amy Owens

Central

Student - Grade - Teacher
Haley Bennett - 8th Grade - Sara Vaughn
Grayson Riggins - 8th Grade - Nancy Holmes
Lily Wishon - 5th Grade - Christy Hutchins
Natalie Yow - 2nd Grade - Olivia Passmore
Lydia Mabe - 2nd Grade - Laura Carter
Kennedy Welch - 11th Grade - Julie Riggins
Rachit Chandrakul - 4th Grade - Marcia Warren
Mollee Maness - 2nd Grade - Karlyn Sugg
EJ Howard - 3rd Grade - Ashley Jones

NCTM Regional Meetings

Three regional meetings will be held this fall.

September 25-27, 2019: Boston https://www.nctm.org/boston2019/?ref=nav
October 2-4, 2019: Nashville https://www.nctm.org/nashville2019/?ref=button
October 16-18, 2019: Salt Lake City https://www.nctm.org/saltlakecity2019/?ref=button

Update on the New 4th Level Math Courses

Reported by Katie Mawhinney, Travis Weiland, and Holly Hirst, Appalachian State University, Boone, NC

In North Carolina a high school diploma requires successful completion of four mathematics courses. For the majority of students these credits are satisfied with NC Math 1, NC Math 2, NC Math 3, and one of several 4th level mathematics courses. Since early 2017, teams of classroom teachers, district math specialists, university faculty, and NCDPI math specialists have been collaborating to revise the standards for courses that meet the 4th level math requirement. The current courses (Advanced Functions and Modeling, Discrete Mathematics, and Precalculus) will be replaced with three redesigned courses beginning in the Fall of 2020. The standards for the new courses have been approved by the General Assembly, and professional development for classroom teachers is ramping up. While all three of these redesigned courses prepare students for introductory level college courses, they differ in content and connections to advanced mathematics. The new course titles, descriptions, and domains and standards are as follows.

Discrete Mathematics for Computer Science

The purpose of this course is to introduce discrete structures that are the backbone of computer science. Discrete mathematics is the study of mathematical structures that are countable or otherwise distinct and separable. The mathematics of modern computer science is built almost entirely on discrete mathematics, such as logic, combinatorics, proof, and graph theory. At most universities, an undergraduate-level course in discrete mathematics is required along with calculus for students who plan to pursue careers as computer programmers, software engineers, data scientists, security analysts and financial analysts. Students will be prepared for college level algebra, statistics, and discrete mathematics courses after taking this course.

Discrete Mathematics for Computer Science Domains and Standards

Number and Quantity:

- Apply operations with matrices and vectors.
- Understand matrices to solve problems.
- Understand set theory to solve problems.
- Understand statements related to number theory and set theory.

Functions:

- Apply recursively-defined relationships to solve problems.

Statistics and Probability:

- Apply combinatorics concepts to solve problems.

Graph Theory:

- Understand graph theory to model relationships and solve problems.
- Apply graph theory to solve problems.

Logic:

- Evaluate mathematical logic to model and solve problems.

NC Math 4

The primary focus of this course is on functions and statistical thinking, continuing the study of algebra, functions, trigonometry and statistical concepts previously experienced in NC Math 1-3. The course is designed to be a capstone to introductory statistical concepts. Additionally, the course intentionally integrates concepts from algebra and functions to demonstrate the close relationship between algebraic reasoning as applied to the characteristics and behaviors of more complex functions. In many cases, students majoring in non-STEM fields will take an entry-level college algebra or introductory statistics course, which students would be well prepared to take after this course. Students who decide to major in a STEM field will be well positioned to take a college precalculus course after taking this course.

NC Math 4 Domains and Standards

Number and Quantity:

- Apply properties and operations with complex numbers.
- Apply properties and operations with matrices and vectors.

Statistics and Probability:

- Create statistical investigations to make sense of real-world phenomena.
- Apply informal and formal statistical inference to make sense of, and make decisions in, meaningful real-world contexts.
- Apply probability distributions in making decisions in uncertainty.

Algebra and Functions:

- Apply properties of function composition to build new functions from existing functions.
- Apply properties of trigonometry to solve problems.
- Apply the properties and key features of logarithmic functions.
- Understand the properties and key features of piecewise functions.
- Understand how to model functions with regression

Precalculus

The purpose of this course is to build upon the study of algebra, functions, and trigonometry experienced in NC Math 1, 2, and 3. This course will grow students' algebraic skills and understanding of functions to deepen understanding of the functions in the course and delve into real world phenomena. This course is designed for students pursuing careers in quantitatively heavy fields, including STEM. Students will be prepared for Calculus, AP Calculus and any entry-level college course after taking this course.

Precalculus Domains and Standards

Number and Quantity:

- Apply properties of complex numbers and the complex number system.
- Apply properties and operations with matrices.
- Understand properties and operations with vectors.

Algebra:

- Apply properties of solving inequalities that include rational and polynomial expressions in one variable.
- Apply properties of solving equations involving exponential, logarithmic, and trigonometric functions.

Functions:

- Understand key features of sine, cosine, tangent, cotangent, secant and cosecant functions.
- Apply properties of a unit circle with center (0,0) to determine the values of sine, cosine, tangent, cotangent, secant, and cosecant.
- Understand the relationship of algebraic and graphical representations of exponential, logarithmic, rational, power functions, and conic sections to their key features.
- Apply properties of function composition to build new functions from existing functions.
- Apply mathematical reasoning to build recursive functions and solve problems.
- Apply mathematical reasoning to build parametric functions and solve problems.

What Next?

These new 4th math courses have implications for high school teachers and administrators, faculty at community colleges and universities, and secondary mathematics teacher educators. Here are some questions for each of these populations to consider in the coming year:

High School Mathematics Teachers and Administrators

- What professional development do teachers need to teach the new standards?
- What instructional resources do teachers have or need to teach the new standards?
- How can students and parents be advised of which course to take based on what best suits a students' career and college pathway?

Community College and University Mathematics Faculty

- What courses will students be well prepared for after taking the new 4th mathematics courses?
- Are there any changes necessary for the curriculum based on the new standards?
- Are there ways you can help support high school teachers in teaching the new standards?

Mathematics Teacher Educators

- Will your programs for preparing secondary mathematics teachers adequately prepare pre-service teachers to teach the content in the new standards?
- How can you support mathematics teachers who are in the field to teach the new standards?

Upcoming Informational Sessions

- Check the NCCTM Annual Conference schedule for numerous sessions by NCDPI and by teachers and teacher leaders from across the state on the new standards. [http://ncctm.org/conferences/state-mathematics-conference/]
- Regional PD Sessions from NCDPI: Dates are to be determined. See the NCDPI website for the link to professional development opportunities. [https://sites.google.com/dpi.nc.gov/k-12-mathematics/home]

Mini-grant Report

Let's Roll with Sphero! (An After-school Coding Club)

Jamie Munn, CD Owen Middle School, Swannanoa, NC

Through multiple years of support through NCCTM's mini-grant program, I was able to get the technology and resources needed to create an after-school robotics club! Specifically, grant funds were used to purchase a dozen Sphero Robots, a charging station, and support materials like ramps and obstacle courses. The reach of this project has impacted not only the students in the club, but also over 100 students a year in my regular math classes, too. A big "thank you" to NCCTM for offering and supporting projects like this one!

Let's Roll with Sphero!

Join the club! *The Sphero Robotics Club that is*. Once a week after school through the winter months, two dozen middle schoolers took on the challenge of programing and driving robotic spheros (https://www.sphero.com/).

Figure 1. Students driving their sphero robots.

By fusing technology with robotics, this project enabled students to learn tech programing, while applying mathematical skills and concepts in an exciting way! The structured lessons were adapted from available resources from the Sphero EDU website (https://edu.sphero.com/).

Through the user-friendly app, *Sphero Edu*, students started by writing block code to create a basic geometric shape (e.g., a square; Fig. 2). Then they progressed to more complicated coding to include loops, delays, lights, and sounds (Fig. 3).

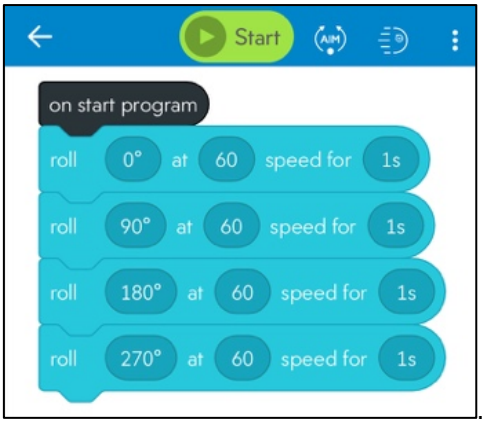


Figure 2. Code to traverse a square.

These lessons provided the groundwork for the independent programming needed to play "putt-putt," the goal of which was to drive the Sphero along the designated path to achieve a "hole in one" (Fig. 4). First, they needed to gather data for the ratio between speed and duration in the block code settings and the actual distance traveled. This data was then used to program the robots to run the multiple challenges in the Putt-Putt course. It proved to require some trial and error to find just the right settings to make a "hole in one".

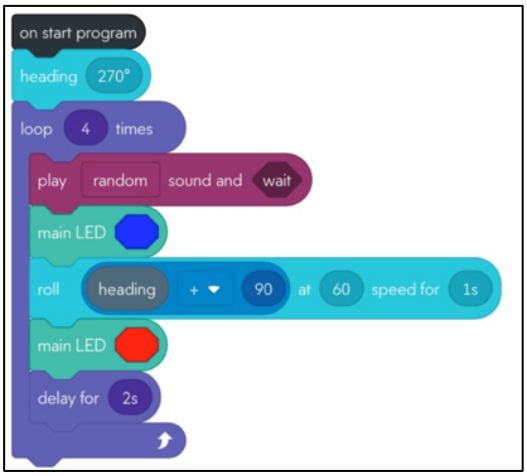


Figure 3. More complicated code – moving, playing sounds, lighting lights, and pausing in a loop.

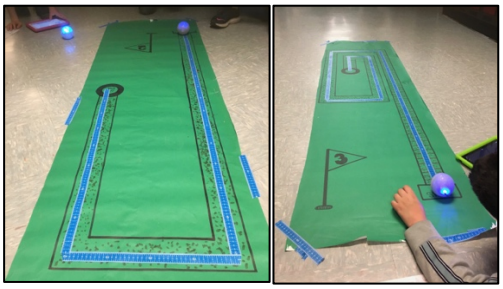


Figure 4. The putt-putt courses.

At the end of each session, students were able to use the Drive function in the Sphero App to explore the remote-control aspects of the robot. Utilizing ramps, long hallways, and obstacles, students practiced their skills at driving and racing the Sphero robots.

In addition to the after-school club, students in my math classes had access to the same programs and devices during the school day. Students from the after-school club became "experts" to guide fellow classmates in how to write the block code to program and drive the Sphero robots. In class, a multiple day project called *Spherolympics* challenged students to program a set distance, create geometric shapes, jump and slalom using the Spheros. Some students reported that *Spherolympics* was their most favorite project of the entire year!

Applying for NCCTM Mini-grants

NCCTM provides funding for North Carolina teachers as they develop activities to enhance mathematics education. This program will provide funds for special projects and research that enhances the teaching, learning, and enjoyment of mathematics. There is no preconceived criterion for projects except that students should receive an on-going benefit from the grant. In recent years, grants averaged just less than $800.

The application is available on the NCCTM website [ncctm.org]. Proposals must be postmarked or emailed by September 15, and proposals selected for funding will receive funds in early November. Be sure that your NCCTM membership is current and active for the upcoming year! Each year we have applications that cannot be considered because of the membership requirement. Email Joy McCormick [jmccormick@rock.k12.nc.us] with questions.

Problems2Ponder

Holly Hirst, Appalachian State University, Boone, NC

Starting in 2018, the Problems to Ponder column received a face lift. The new Problems2Ponder will present problems similar to those students might encounter during elementary and middle school Olympiad contests.

Student submissions are still welcome as are problem submissions from teachers. Please consider submitting a problem or a solution! Enjoy!

Problem submissions are welcome! If you have an idea for a problem to publish, please email Holly Hirst (hirsthp@appstate.edu) a clear photo or PDF document of a typed or neatly written problem statement, along with a solution. Include your name and school affiliation so that we can credit you with the submission.

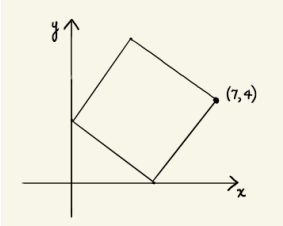
Solution submissions are welcome! In particular, if teachers have an exceptionally well written and clearly explained correct solution from a student or group of students, we will publish it in the next edition of The Centroid. Please email Holly Hirst (hirsthp@appstate.edu) a clear photo or PDF document of the correct solution, with the name of the school, the grade level of the student(s), the name of the student(s) if permission is given to publish the students' names, and the name of the teacher.

Deadline for publication of problems or solutions in the Spring 2020 Centroid: December 31, 2019.

Fall 2019 P2P Problems

Problem A: Two consecutive positive integers are each less than 100. One integer is divisible by 17, and the other integer is divisible by 21. Find the two integers.

Problem B: A square is positioned in quadrant I of the Cartesian Coordinate system so that one vertex lies on the x-axis, an adjacent vertex lies on the y-axis, and a third vertex lies at the point (7,4). Find the area of the square.



Solutions will be posted in the next edition of The Centroid.

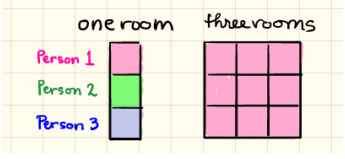
Spring 2019 P2P Problem Solutions

These two problems both involved counting carefully.

Problem A: It takes three people 1 hour to fill a storage room with boxes. How long would it take one person to fill three storage rooms, assuming all of the people work at the same rate and all of the rooms are the same size?

Solution: There are several ways to find an answer!

(1) Find the time for one person: Since three people need 1 hour to fill the room, one person working alone would take 3x1 = 3 hours. Therefore, it would take one person 3x3 = 9 hours to fill three rooms.



(2) Find the part of the room that can be filled in one hour by one person: Since three people need one hour to fill the room, one person can fill 1/3 of a room in one hour. So one person working alone would need 3 hours to fill a room, and again we arrive at 3x3=9 hours to fill three rooms.

Problem B: How many different fractions (in lowest terms) between 1/4 and 3/8 are exactly equivalent to a decimal that is written using 3 decimal places?

Solution: Let's first convert these fractions to decimals: 1/4 = 0.25 and 3/8 = 0.375. But! Let's write 0.25 as 0.250, so that we can see more clearly that we need to count 0.250, 0.251, 0.252, … 0.373, 0.374, 0.375. How many numbers are in this list?

Be careful! There are 375 three-digit numbers from 0.000 to 0.375, and there are 249 numbers in this list that are smaller than 0.250, so 375-249 = 126 different three-digit decimal numbers between the two fractions, and these could all be represented as different fractions in lowest terms. COOL!

Innovator Award Nominations

The North Carolina Council of Teachers of Mathematics accepts nominations for the Innovator Award at any time. The Committee encourages the nomination of organizations as well as individuals. Any NCCTM member may submit nominations. The nomination form can be obtained from the "awards" area of the NCCTM Website, www.ncctm.org. More information can be obtained from: Dr Rose Sinicrope, sinicroper@ecu.edu.

Rankin Award Nominations

The Rankin Award is designed to recognize and honor individuals for their outstanding contributions to NCCTM and to mathematics education in North Carolina. Presented in the fall at the State Mathematics Conference, the award, named in memory of W. W. Rankin, Professor of Mathematics at Duke University, is the highest honor NCCTM can bestow upon an individual.

The nomination form can be obtained from the "awards" area of the NCCTM Website, www.ncctm.org. More information can be obtained from Lee V. Stiff, lee_stiff@ncsu.edu.

Celebrate 100 Years of NCTM!

Did you know that the National Council of Teachers of Mathematics, NCCTM's parent organization, will turn 100 in 2020? The NCTM Centennial Meeting and Exposition will be held in Chicago from April 1-4, 2020. There is a conference strand for all interests!

Implement the Effective Teaching Practices
Experience the Depth and Excitement of Mathematics
Look Back and Move Forward: A Centennial View
Create Positive Change
Build Student Agency, Foster Student Identity, and Promote Social Change

For more information, check out: https://www.nctm.org/100/

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contact information can be found at ncctm.org

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NORTH CAROLINA COUNCIL OF TEACHERS OF MATHEMATICS

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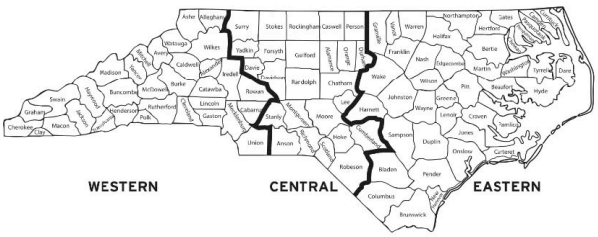

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