

Freedom

Mathematics on the Un

This lesson was inspired by two literary sources, *Sweet Clara and the Freedom Quilt* (Hopkinson 1993) and *Hidden in Plain View* (Tobin and Dobard 1999). In *Sweet Clara and the Freedom Quilt*, Clara makes a quilt that serves as a map to escape slavery and the plantation on which she works. In *Hidden in Plain View*, Ozella, a descendent of African slaves, describes a quilt code shown by laying quilts outside to air or dry that informed Africans of the tools needed to escape.

Quilting requires quilt makers to apply an extensive amount of mathematical knowledge. Quilt makers determine the amount of material they need and how to fit the different pieces together to create a beautiful, high-quality quilt. Through my own quilting practice, I see the application of such mathematical topics as measurement, geometry, and arithmetic, along with an appreciation for the strong cultural aspect associated with quilting.

Quilting activities in the mathematics classroom engage students in the use of mathematics in the real world. The NCTM Standards (2000) advocate providing students with opportunities to “learn mathematics by working on problems that arise in a context outside mathematics” (p. 65). Not having conventional measurement tools to make different quilt patterns, children must think about the properties of the shapes that they are making, not just recognize them. The mathematics activity presented in this article is a lesson that I frequently

teach upper elementary school students. Through this activity students see the connection of mathematics with a real-world activity, appreciate the tremendous mathematical knowledge required of quilt makers, reinforce their knowledge of the geometrical properties of different shapes, and bring together the history of the Underground Railroad and mathematics.

Freedom Quilts: A Brief History

Many common quilt patterns were used as means for secret communication on the Underground Railroad on some southern plantations. The quilts told escaping Africans the tools and materials they needed to gather or were used as maps for slaves’ upcoming journey north. Law prohibited teaching Africans to read or write, so other methods were used to ensure a successful escape. Most information regarding an escape had to be committed to memory and passed on only by word of mouth, using codes, signs, and signals created by Africans and heard only by those who could be trusted (Tobin and Dobard 1999). By using quilts, an item seen every day, Africans were able to communicate messages about plans to escape in front of their masters without drawing suspicion.

The quilt code and map quilt are made up of several geometric patterns, mostly consisting of squares, rectangles, and right triangles. These quilts were made without the help of rulers, protractors, or other tools used in modern quilt making.

Sweet Clara’s quilt

In the quilt that Clara made, one sees a map of the area surrounding the plantation, along with different landmarks that Clara used to escape bondage. She

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Quilts:

Underground Railroad

used a nine-square quilt pattern to show other plantations and their crops. She used rectangles and triangles to represent different houses on other plantations. She also made a northern star to show the direction that she planned to take on her journey.

Ozella's Underground Railroad quilt code

For the quilt code, different quilts were used to direct Africans to take particular actions in their preparation to escape slavery. These quilts remained in public view for the time allotted to complete the signaled task. A *sampler quilt* (see **fig. 1**) included all the different patterns arranged in the order of a quilt code to help quilt makers sew the different quilts.

The following description of the different quilts, seen in **figure 1**, represents parts of the code described by Ozella. Because this story has been passed down from generation to generation, some quilt-code meanings have been lost or interpreted differently.

- When the Monkey Wrench quilt pattern was displayed, the Africans gathered the tools needed for their journey north.
- The Bear's Claw pattern referred to the path that fleeing Africans took. It reminded escaping Africans to follow the actual trail of a bear's footprints across the Appalachian Mountains.
- The Crossroads represented a northern city, which served as a major terminal on the Underground Railroad, a port to Canada, and the crossroads to the north.
- The Log Cabin quilt informed the escaping Africans to find shelter at various "way stations along the Underground Railroad" (p. 34). The belief was that escaping Africans would recog-

nize these safe houses through the display of a Log Cabin quilt with the inside square of a certain color.

- The Shoofly quilt pattern referred to an actual person who may have helped the escaping Africans by giving them important information.
- Once the Africans made their way to the northern cities, they had to dress up in "cotton and satin bow ties" (p. 36) so as to fit in and not look as if they had just come from the plantations.
- The Flying Geese pattern gave directions to fleeing Africans. To inform the Africans which direction to go on their journey, one set of triangles was sewn in a different color combination (see **fig. 2**).
- Following the Drunkard's Path was a warning to the Africans to move in a zigzag fashion so as to elude any slave trackers who might be following them.

Figure 1

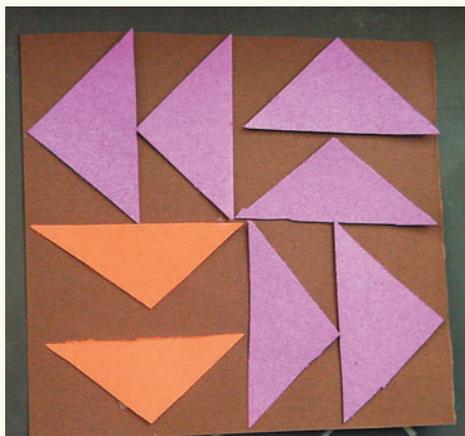
Sampler quilt



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Figure 2

Flying Geese pattern directing people to go south



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- The Star represented the North Star, which the Africans were to follow as they navigated toward freedom (Tobin and Dobard 1999).

Freedom Quilt Activity

Description

In this activity, students begin by making the different quilt codes told by Ozella so that they can practice making geometrical shapes without rulers or protractors. Next, students create their own map quilt for going to school by using codes they created, just as Ozella's ancestors and Clara did for their quilts. Children need to work together to determine how they will make their map quilt and what codes they will use. They will also use the properties of a geometrical shape to determine whether they have actually created that shape.

Getting ready: A teacher's guide

Learning goals and NCTM Standards: Students will analyze the characteristics and properties of two-dimensional geometrical shapes and develop mathematical arguments about geometrical relationships. Students will use visualization, spatial reasoning, and geometrical modeling to solve problems. Students will also select an appropriate unit and tool for the geometrical shape being measured. Students will broaden their knowledge of mathematical applications within a cultural context.

Connecting mathematical content with research: The Van Hiele levels describe the mental development of geometrical thinking (Davey and Holliday 1992). The first three levels, reasoning by recognition, reasoning by attributes, and reasoning by relationships among the attributes, are characteristic of K–5 students' development (Fox 2000). Students will progress through these levels of understanding by doing this activity. Students begin their geometrical thinking by connecting geometrical shapes in the quilts with objects they see in their everyday life. Students move to reasoning about shapes in more analytical ways with scaffolding and guidance. For example, a square has four right angles and four sides of equal length, and the diagonals of a square are of equal length. Students then learn how different shapes are related to each other. For example, all squares are quadrilaterals but not all quadrilaterals are squares.

By using body units as nonstandard units of measure, children in the upper elementary grades revisit the idea of the meaningful need for, and use of, standard measurement tools. As students decide which measurement units they will use (for example, a hand, a finger, a knuckle length), they must consider the scale of their map and how the different pieces of their map fit together. Students develop these fundamental ideas about measurement as they refine their ability to use measuring tools correctly (Van de Walle 2003).

Materials needed

1. For the opening activity and discussion, display the Sampler Quilt for student reference (see **fig. 1**).
2. For the exploration, each group of four students will need a 9-inch-by-12-inch envelope that contains the following materials: scraps of different colored construction paper (Africans were given only scrap pieces of material to make their quilts), scissors, paper glue, tape, string, chalk, and four pieces of 8-inch-by-11½-inch construction paper to serve as quilt backing for one code pattern. The envelopes serve as kits that include all the materials and tools needed to make the quilt-code pattern and map quilt.
3. For the application, a copy of *Sweet Clara and the Freedom Quilt* (Hopkinson 1993) will be needed. Each group of four students will need a piece of flip-chart paper (27 inches by 34 inches) to represent the quilt matting and the material in the envelopes from the exploration phase of the activity. Note: Other books that can

be used as a springboard for this lesson are listed in the “Teacher Resources” section at the end of this article.

Activity time: One 45-minute session for the discussion and exploration and a 75-minute session for the application.

Part 1: Opening the activity

Display a sampler quilt of the different code patterns used to communicate to other Africans the actions needed to prepare for their escape to freedom (see **fig. 1**). Explain Ozella’s Underground Railroad quilt code and how the different patterns represented codes for the African slaves. If you wish to maintain the oral tradition, verbally explain the directions to your students.

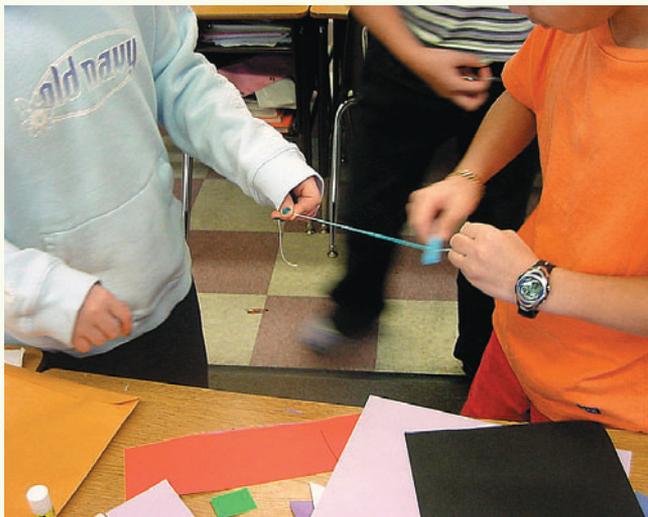
Part 2: Discussion of geometrical ideas

This discussion time enables students to reveal their thinking on what they see in the quilt patterns and how they understand the properties of the shapes they see. The following questions are helpful to pose to students in guiding this discussion.

1. What shapes are used in the code that Ozella recites, as seen on the sample quilt? In what ways are the geometrical shapes used to display the code? Why would Africans use these shapes? (Students should realize that four squares are put together to make crossroads or that squares and right triangles are used to make a Bear’s Claw.)
2. How could the different shapes used to symbolize the quilt patterns be made without conventional tools? This question helps initiate a discussion of the geometrical properties found in these shapes, for example, (a) if the diagonals of a quadrilateral are equal, then the quadrilateral is a square; (b) some of the triangles in the code are right triangles that are made by cutting a square in half along the diagonal; (c) other triangles in the code are made by cutting the square into quarters along the two diagonals, resulting in four right triangles; and (d) the two diagonals of a square intersect perpendicularly, so that the four triangles are right triangles.
3. Imagine how Ozella would have made these shapes with only string and scissors for tools. How could she ensure that a square is really a square? And that a right triangle is really a right triangle? (The chalk and string can make a

Figure 3

Students marking the string with chalk



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straight line by marking the string with chalk [see **fig. 3**], holding the string taut, and then snapping it against the paper, thereby creating a chalk line [see **fig. 4**]. The children can use non-standard measurement units to measure a given distance to make two parallel chalk lines. If the children are not familiar with measuring by

Figure 4

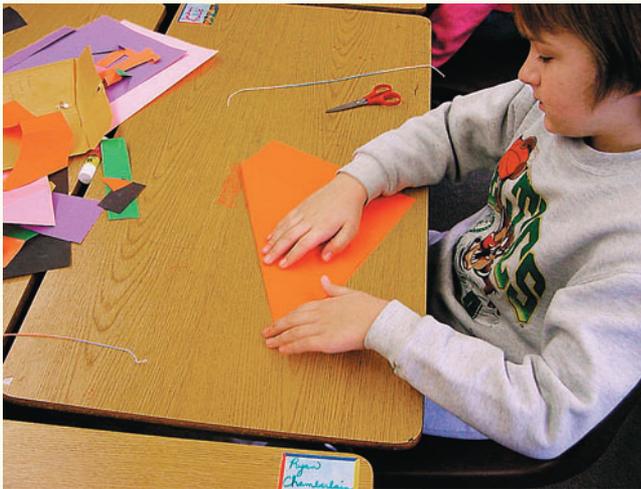
Students snapping the string against paper to make a straight line



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Figure 5

A student determining whether the lengths of the square are equal



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Figure 6

A student using a purple house to represent a safe home on her map quilt



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using nonstandards units, show them how to measure with parts of the body [fingers, hands, and so on]. Students can then make the square by cutting along the two parallel lines and fold the two opposite corners on the quadrilateral until they find the point at which the two diagonals are equal. **Figure 5** shows a student figuring out whether his quadrilateral is a square by folding the opposite corners of the shape.)

Part 3: Exploration

The exploration time helps students practice making geometrical shapes without using rulers or protractors.

1. Students choose one of the patterns from Ozella's quilt code that they wish to make. (By choosing which quilt-code pattern they will make, students enter into the activity at their comfort level, thus differentiating the level of engagement and the instructional need themselves.)
2. When the students finish building their quilt-code pattern, pause for discussion. Ask the students why they chose that particular quilt pattern. Some students may pick a pattern because they remember being told about it by a relative or friend. What did they notice about making the quilt without using any modern tools to help them form the squares or right triangles? (Many students will comment on the difficulty of making squares without conventional tools. For students who are completely struggling to make the squares without conventional tools, have some square templates available.) Some students will also talk about remembering the codes they were told as their reason for picking the pattern. An example of a quilt-code pattern that a student chose to make is seen in **figure 2**.

Part 4: Application

Quilts were also used as maps to help Africans learn escape routes from a plantation. Read to the class *Sweet Clara and the Freedom Quilt*, which describes the use of geometrical shapes in map quilts to help Africans escape from a different plantation. Emphasize to students that the purpose of the Freedom Quilts was to hide a message or a map in plain view so that the slave owner would not become suspicious. The goal for students in this phase of the activity is to create a map quilt so that only those "in the know" understand how to use it.

In groups of four, ask children to make one quilt that serves as a coded map of the way to school. Students can use squares, rectangles, triangles, circles, and semicircle shapes to represent different objects on their map quilt. Just as they have done in the exploration phase, students should use nonconventional tools to make their map quilts.

Have the students use the material in their kits to make their map quilt. Students need to plan out their maps and the codes they will use before making their map quilts. Because many of the students come from different neighborhoods, as a group

they must decide how to handle this issue.

After children have made their map quilts, invite them to share their code with the class. The ways children “hide” the directions to school in their map quilts often are highly creative (see **figs. 6, 7, and 8**).

Conclusion

This quilting activity engages students in applying mathematics in a real-world context. It prompts them to examine and use the geometrical properties of the shapes that they make, not just name the shapes by rote. The interdisciplinary nature of this activity highlights the extensive mathematical knowledge needed by quilt makers and brings the history of the Underground Railroad to life for students as they pursue authentic mathematical tasks.

Teacher Resources

Alternative springboard books

- Bial, Raymond. *With Needle and Thread*. New York: Houghton Mifflin Co., 1996.
- Brumbeau, Jeff. *Quiltmaker's Gift*. New York: Scholastic Press, 1999.
- Cohen, Luanne. *Quilt Design Masters*. Palo Alto, Calif.: Dale Seymour Publications, 1996.
- Flournoy, Valerie. *The Patchwork Quilt*. New York: Scholastic, 1996.
- Polacco, Patricia. *The Keeping Quilt*. New York: Aladdin, 1988.
- Ringgold, Faith. *Tar Beach*. New York: Crown Publishers, 1991.
- . *Aunt Harriet's Underground Railroad in the Sky*. New York: Scholastic, 1992.
- . *Dinner at Aunt Connie's House*. New York: Scholastic, 1993.

Web sites

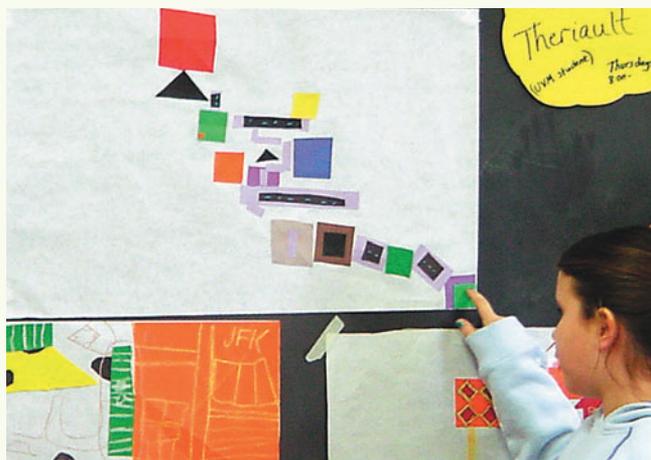
- www.carolhurst.com/subjects/quilts.html
- www.pbs.org/americaquilts/centry/stories/faith_ringgold.html
- www.womenfolk.com/historyofquilts/abolitionist.htm

References

- Davey, Geoff, and Jack Holliday. “Van Hiele: Guidelines for Geometry.” *The Australian Mathematics Teacher* 48 (February 1992): 26–29.
- Fox, Thomas. “Implications of Research on Children’s Understanding in Geometry.” *Teaching Children Mathematics* 6 (May 2000): 572–76.
- Hopkinson, Deborah. *Sweet Clara and the Freedom Quilt*. New York: Alfred A. Knopf, 1993.
- National Council of Teachers of Mathematics (NCTM). *Principles and Standards for School Mathematics*.

Figure 7

To disguise their map code on their quilt, the students in this group explained that they chose green squares to represent safe places. They used the red square at the top to represent the school. They chose right triangles to stand for parking lots. They selected a blue square to represent a nearby pharmacy because it had a blue sign on the front of the building.



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Figure 8

The student is pointing to the crosswalk that students must cross to get to school. The group used the same code pattern as the “crossroads” pattern told by Ozella.



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- Reston, Va.: NCTM, 2000.
- Tobin, Jacqueline, and Raymond Dobard. *Hidden in Plain View: A Secret Story of Quilts and the Underground Railroad*. New York: Doubleday, 1999.
- Van de Walle, John. *Elementary and Middle School Mathematics: Teaching Developmentally*. 5th ed. Boston: Allyn & Bacon, 2003. ▲