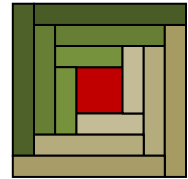


Tying Quilts to Montessori Math and Geometry



AMS Conference, March 2011, Chicago – Jane Lemon and Sue Clark,
jclemon@mpsaz.org, smithclark@msn.com

Summary: Examining quilt block designs offers opportunities for linking an interesting cultural item to math and geometry skills, ranging from studies of lines and two-dimensional shapes, to fractions, calculations, tessellations, symmetry, and rotations. Recreating quilt blocks with pattern blocks explores aspects of equivalence, transformations, and patterning.

The [Log Cabin] pattern brings to mind the warmth of hearth and home. Beginning with a center block, called the “chimney,” which is often in a red or another warm color that symbolizes the fire, each “log” overlaps the one before, until a square of the desired size is formed. In the classic formation, colors are arranged so that half of the square is of light colored logs and the other half is of dark logs. The squares can be manipulated so that the light and dark sides form an overall design on the quilt top.

– Roderick Kiracofe, *The American Quilt*

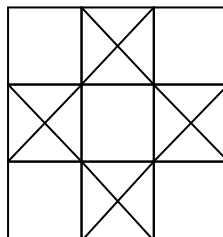
We all know that Culture is the heart and soul of the Montessori Elementary curriculum, and that cross-curricular links are important in our classrooms. We must cover Standards, but they can be somewhat dry if done in isolation. One strategy is to plan lessons so that multiple standards are covered in each. Combining Culture and Math can encourage, enrich and enliven your students, while meeting two or more standards at once.

Introductory ideas to do before or in conjunction with this unit: History of quilting, Quilting traditions around the world, Westward Expansion, Civil War, Underground Railroad possibilities, making quilts (fabric or paper), show and tell with real quilts. ***See Appendix for resources.***

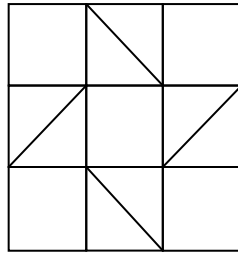
NOTE: Miniature quilt blocks throughout this handout may be colored and/or annotated to jog your memory later.

FRACTIONS IDEAS:

1. Designate one part of a quilt block as 1. Compare the other parts and express them as a whole number or fraction. For example, in the Ohio Star, if the central square is 1, there are five squares with the value of 1. Each of the sixteen triangles has the value of $\frac{1}{4}$.

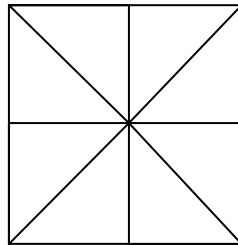


2. Designate one part of a quilt block as 1. Compare and assign value to the other parts and add to find the value of the whole block, e.g., in the Friendship Star, if the value of the central square is 1, each of the eight triangles has the value of $\frac{1}{2}$. The block would equal $1 + \frac{1}{2} + \frac{1}{2} + 1 + \frac{1}{2} + \frac{1}{2} + 1 + \frac{1}{2} + \frac{1}{2} + 1 + \frac{1}{2} + \frac{1}{2} + 1 = 9$.

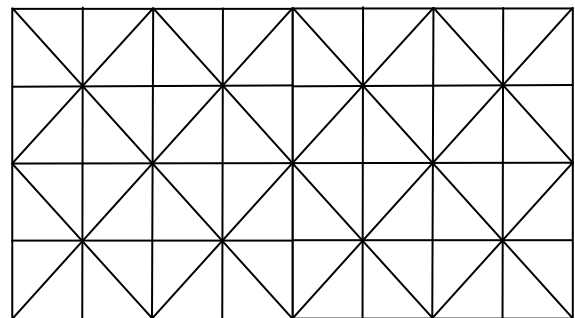
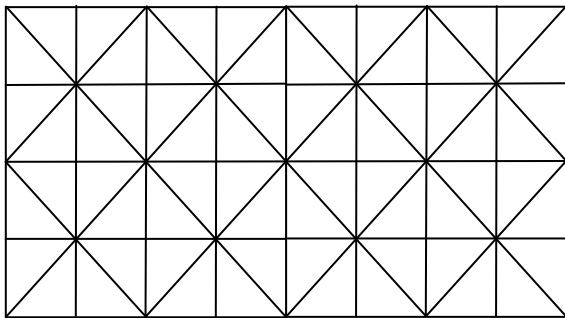


Variation for #1 and 2: Express parts as decimal fractions.

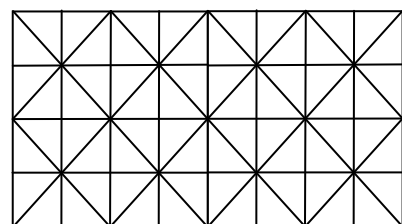
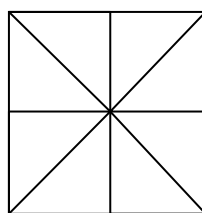
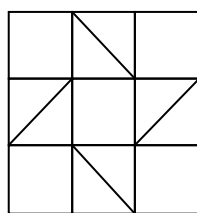
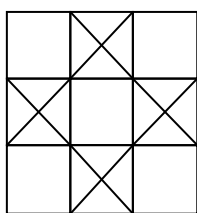
3. Designate the entire block as 1, and assign a value to each fractional piece, e.g., in the Pin Wheel, if the entire block has the value of 1, each triangle has the value of $\frac{1}{8}$. $1 = 8(\frac{1}{8})$.



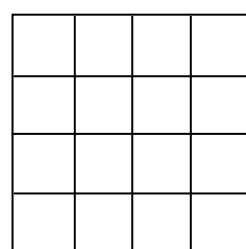
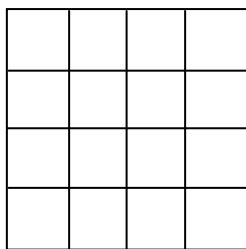
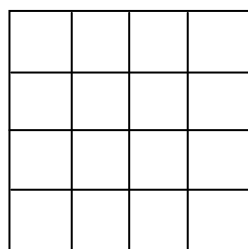
Extension for #1 -3: these same activities can be done using an entire quilt



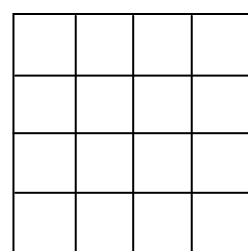
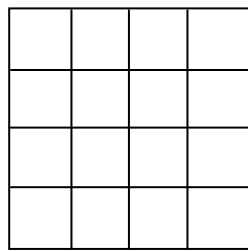
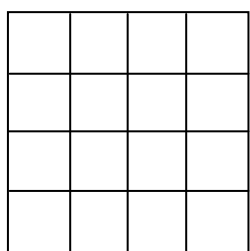
4. Have the students use pattern blocks to design quilt blocks. A particular part can be given the value 1 and the other parts expressed as whole numbers or fractions as in #1 above. Pattern blocks can also be used for #2 above. A quilt block or entire quilt made from pattern blocks can be analyzed as in #3 above. (idea from Clockwatchers, Inc. – www.QuiltingAssistant.com)



5. Fractions can be used to design quilt blocks. Have the students take a paper square and fold it into fourths horizontally and vertically so that 16 squares are formed. Have the students color these squares so that half of them are one color (e.g., blue) and half another (e.g., yellow). Challenge the students not to have all the blue squares on one side of the midline. View the variety of designs. The finished quilt blocks could be assembled into a quilt. In looking at the entire quilt, what fraction of the whole is colored blue? ($\frac{1}{2}$) The same activity could be done for fourths or eighths. (idea from Clockwatchers, Inc. – www.QuiltingAssistant.com)

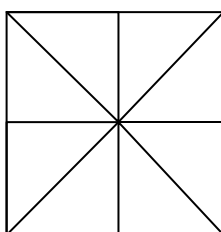


6. Cut colored paper into 1 cm squares. Provide students with a template - a 4 x 4 grid marked off in 1-cm increments (or 8 x 8, 12 x 12, etc.). Allow the students to compose designs on their templates using fractional parts of each color. For example, one could choose 8 red squares representing $\frac{1}{2}$ of the design, 4 yellow squares representing $\frac{1}{4}$ of the design, 2 orange and 2 white each representing $\frac{1}{8}$ of the design. The block would have the value of $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{8} = 1$. Blocks could be assembled into a paper quilt, and the value of the entire quilt could be calculated.

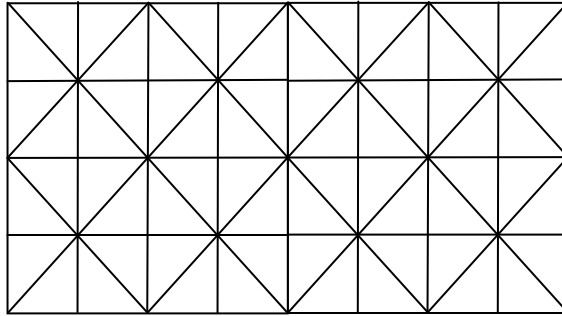


ADDING AND/OR MULTIPLYING IDEAS:

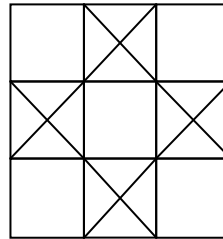
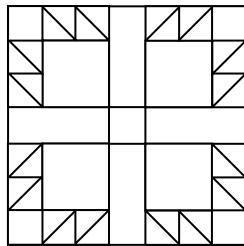
7. Give one part of a quilt block a value. Use its size relationship to the other shapes in the block to compute the block's value; e.g., in the Pin Wheel block, if each triangle has the value of 3, the quilt block has the value of $8 \times 3 = 24$.



Extension: examine an entire quilt

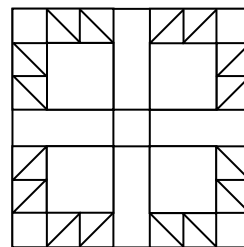
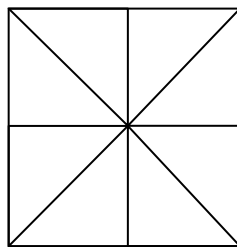


8. Have the students use pattern blocks or paper squares and triangles. Give one piece a value. Use its size relationship to the other pieces to establish each quilt block's value. Make a design and compute the value, or choose a value and make a design to equal that value.



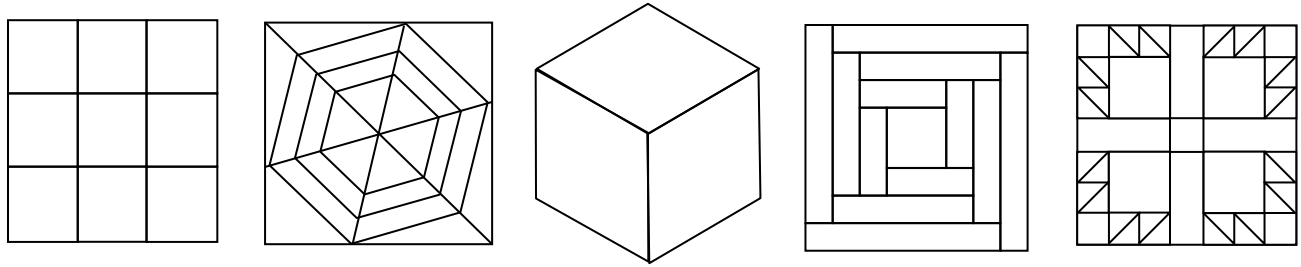
DISCRETE MATHEMATICS IDEAS:

9. Have the students examine a quilt block and analyze whether two edges share the same color. (For example, no two edges in the Pin Wheel design do, while several edges in the Bear's Claw design do have edges touching with the same color.) Quilt blocks could then be categorized as to whether they have edges that share a color or do not.

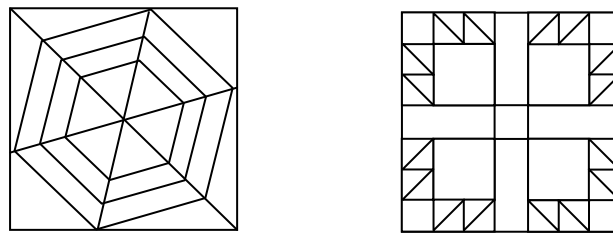


As the quilt draws us in, we respond to its colors, shapes, patterns, and overall theme on a personal level. The quiltmaker's goal is to incorporate contrast, repetition, and depth over the surface of the quilt in a way that totally mesmerizes the viewer. This creative interplay is achieved primarily through fabric – the quiltmaker's palette. – Flavin Glover, A New Look at Log Cabin Quilts

10. Have the students choose a quilt block pattern and color it so that no two edges within it share the same color. The same color may touch at a point. Have them justify why they use the number of colors.



11. Have the students use pattern blocks to design quilt blocks so that no two edges within the blocks share the same color. Have them justify why they used the number of colors. (Remind them that if there are spaces, the spaces constitute another color.)

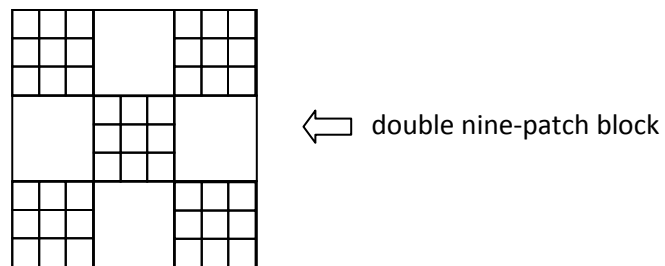


Extension: Specify how many colors (two, three, or four) can be used for the design.

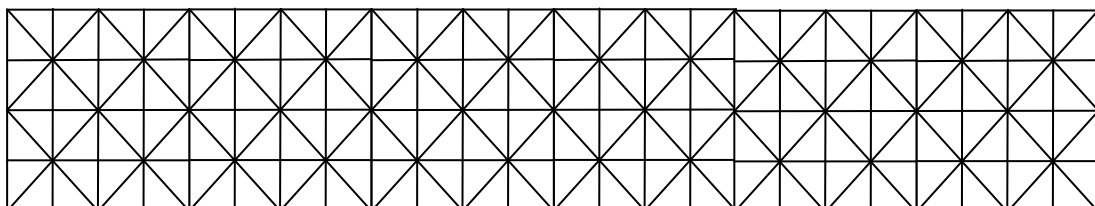
NOTE: This activity comes from a very famous coloring problem in mathematics, which only recently has been proven. It states that no map exists on a flat surface that requires more than four colors to complete it so that no two edges share the same color.

PATTERNS AND ALGEBRA IDEAS:

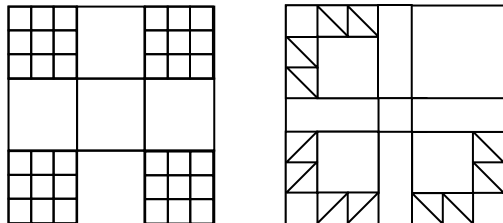
12. Have students examine quilt blocks or quilts to recognize and describe the pattern.



13. Have the students use pattern blocks (or quilt blocks) to create or extend a pattern.



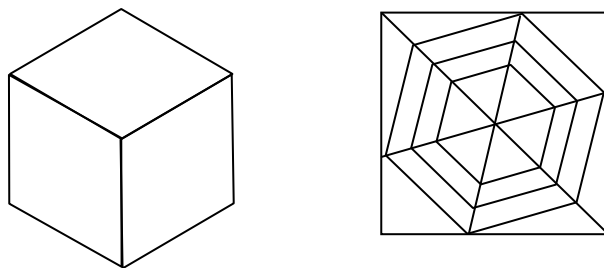
14. Remove a portion from a quilt (or quilt block). Have the students identify the missing pattern.



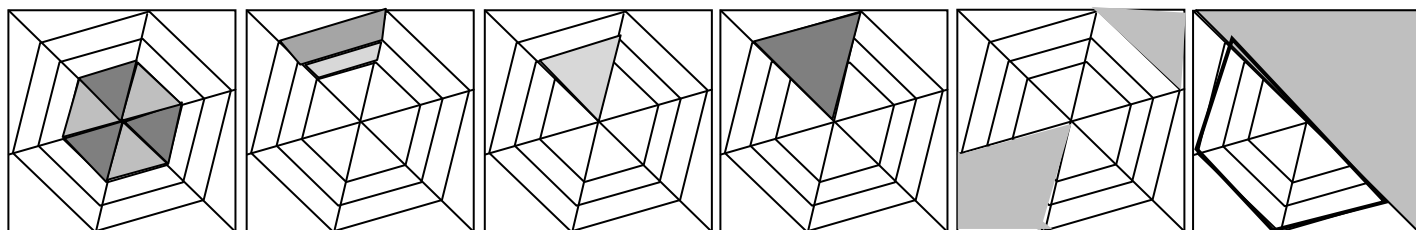
Variations & Extensions: Students recreate missing portion using pattern blocks or a sketch.
Use a photo of a real quilt and mask off a certain portion.

GEOMETRY IDEAS:

15. Analyze a particular quilt block. Have the students look for any of the following: lines; angles; parallel, perpendicular, or oblique lines; right, acute or obtuse angles.

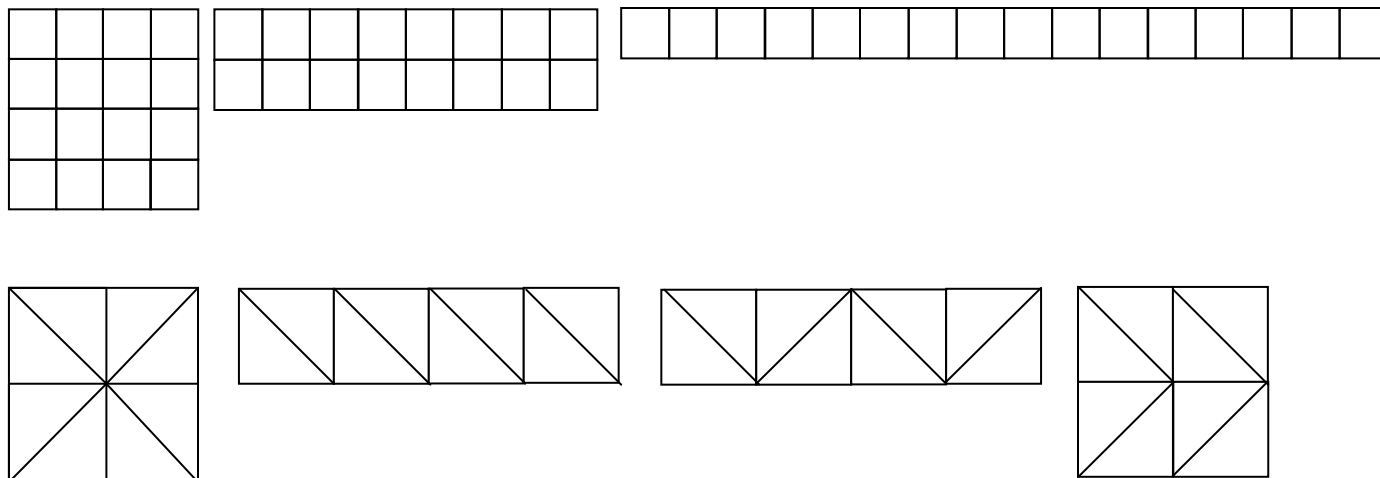


16. Analyze a particular quilt block. Have the students point out the various geometric shapes remembering that a square is a perfect rectangle. For example, in the Cobweb, there are six equilateral triangles in the center. Two trapezoids are next to each of the central triangles. Each one of the trapezoids joined to its triangle forms another equilateral triangle. There are four triangles extending from the center to the outer edges. There are two kites extending from the center to the outer edges. There are three hexagons. Two right triangles are at two of the corners with two chevrons at the other two corners. There are two large right triangles using the diagonal and two trapezoids using the line from side to side. Lastly, the entire figure makes a square.



Order is the shape upon which beauty depends. – Pearl Buck

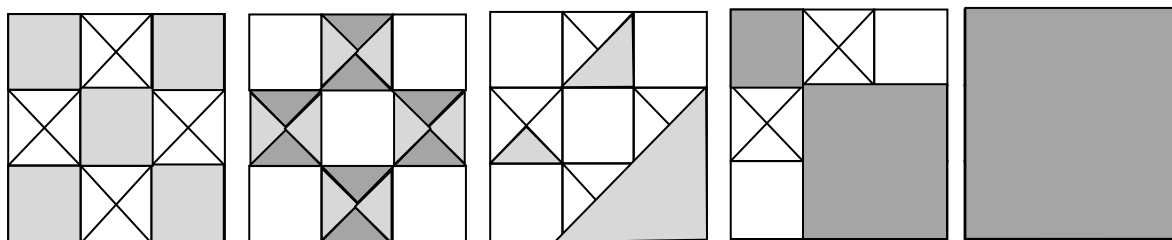
17. Have the students composing and decomposing paper quilt blocks by cutting them up and rearranging them into different arrays. (Students can also use quilt blocks to compose entire quilts, then decompose and rearrange.) Have them compare the results, including whether the shape, pattern, area, and/or perimeter changes.



Variations & Extensions: Compare these figures with bead bars (products, factors).
Calculate area. Calculate perimeter. Students graph the changes.

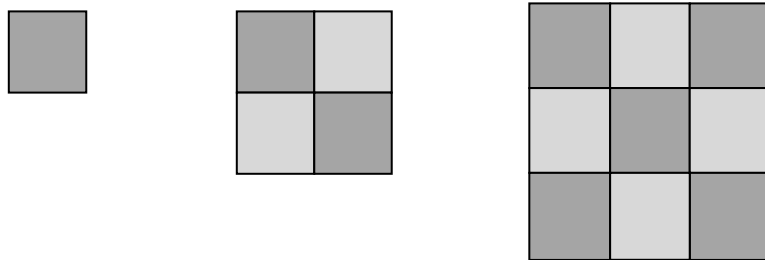
18. Have the students compose and decompose quilt blocks as in #17 but using pattern blocks, again comparing the results.

19. Have students analyze quilt blocks for similar and congruent figures. For example, in Ohio Star, there are five congruent squares and 16 congruent small right triangles. There are three sets of similar right triangles – the smallest, two small ones together, and a corner of the design that is composed of two small right triangles, a square, and two more small right triangles. There are three similar squares – the smallest, four together, and the entire block. (There are other similar right triangles and squares.)

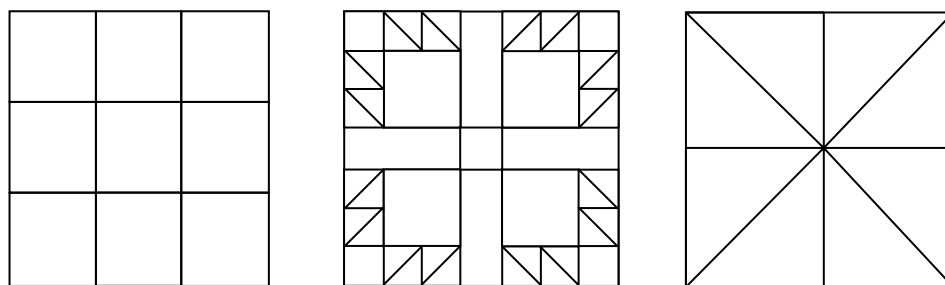


More of each are present

20. Using pattern blocks, the students create similar figures by combining figures of the same shape, e.g., a square, four squares arranged 2 x 2, nine squares arranged 3 x 3, etc.



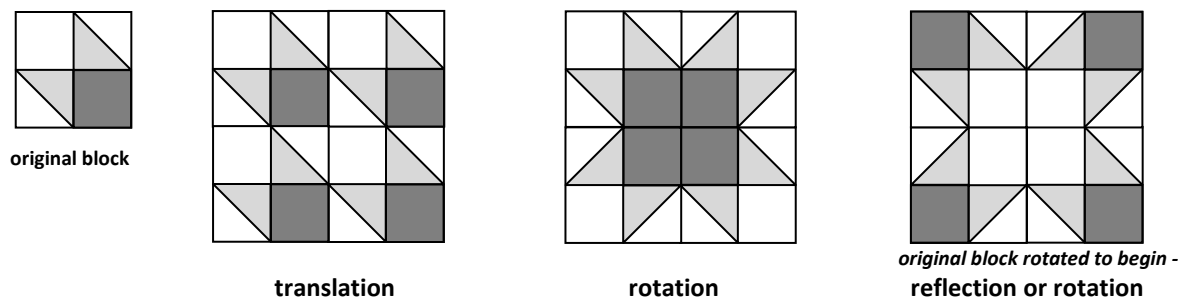
21. Have students analyze quilt blocks (e.g., Nine Patch) to point out a pattern that is slid (translated). At another time, choose a quilt block (e.g., Bear's Paw) to point out a pattern that is flipped (reflected). Note: Bear's Paw could also be seen as a rotation. At another time, choose a quilt block (e.g., Pin Wheel) to point out a pattern that is turned (rotated)*.



* If we look at the square composed of a white and green triangle, this square is rotated. If we examine the triangle shape, it is flipped (reflected) around the center of the block.

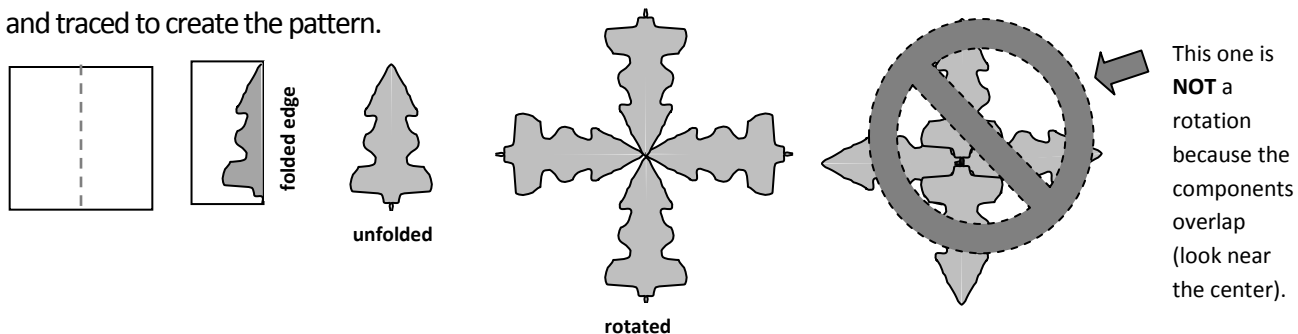
Extensions: Examine an entire quilt and analyze whether the pattern is a translation, rotation, or reflection.

22. Have students design a quilt (tessellation) using slides (translation), turns (rotation), or flips (reflection). They could use cut paper and glue it to a template, as in #6, above.



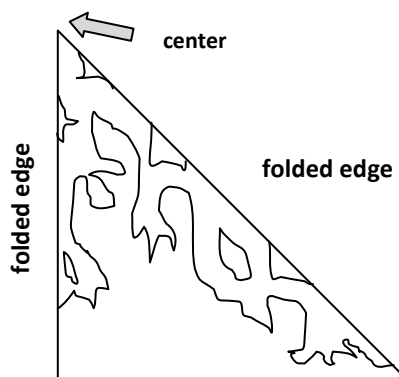
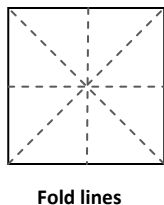
Extension: Research Islamic design or mosaics.

23. Give students a paper square and have them fold it in half forming two congruent rectangles. Have the students draw an interesting line from a point near the top of the fold to a point near the bottom of the fold. Have them cut along the line. A symmetric figure is formed with the fold as the line of symmetry. This figure will serve as a template to create a quilt block or entire quilt. It can be slid, rotated, or reflected, and traced to create the pattern.



Extensions: Have the students fold the square along a diagonal. Two congruent right triangles are formed. Proceed as before. The paper can be folded horizontally and then vertically giving two lines of symmetry, or along both diagonals. Examine Hawaiian quilts.

Sample of cutting design for a Hawaiian quilt (entire quilt):



24. Have students examine quilt blocks looking for lines of symmetry.

Extension: Examine an entire quilt.

Hawaiian Quilt – Breadfruit design



PROBLEM SOLVING:

Numerous strategies are used throughout.

MEASURING:

Numerous strategies could be applied throughout.

RATIO AND PROPORTION are possible additional areas of study.

APPENDIX**Common Core State Standards for Mathematics – ones that apply to topic****Kindergarten****Counting and Cardinality**

Counting to tell the number of objects

Geometry

Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cylinders, and spheres).

Analyze, compare, create, and compose shapes.

Grades 1 - 8**Operations and Algebraic Thinking**

Represent and solve problems involving addition and subtraction. (1st)

Work with equal groups of objects to gain foundations for multiplication. (2nd)

Represent and solve problems involving multiplication and division. (3rd)

Number and Operations – Fractions

Develop an understanding of fractions as numbers. (3rd)

Extend understanding of fraction equivalence and ordering. 4th)

Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers. (4th)

Use equivalent fractions as a strategy to add and subtract fractions. (5th)

Measurement and Data

Geometric measurement: understand concepts of area and relate area to multiplication and to addition. (3rd)

Geometric measurement: understand concepts of angle and measure angles. (4th)

Geometry

Reason with shapes and their attributes. (K – 3rd)

Draw and identify lines and angles, and classify shapes by properties of their lines and angles. (4th)

Classify two-dimensional figures into categories based on their properties. (5th)

Understand congruency and similarity using physical models, transparencies, or geometry software. (8th)

NOTE: Complete version of the Common Core Standards available from www.corestandards.org

Bibliography

MATH AND GEOMETRY

Developing Mathematics with Pattern Blocks – K-5 – by Paul Swan and Geoff White, 2006 - fractions, space, shape and special relationships, trading games
www.quiltingassistant.com

Resource books, etc.

The American Quilt – a history of cloth and comfort 1750-1950– Roderick Kiracofe, 1993, Clarkson Potter Publishers – splendid reference to all things fabric, especially quilts, many photos, 290 p.
Traditional Quilts from Around the World – Miranda Innes – Japanese, Amish, Seminole, Kuna, Hawaiian, West African, Swedish, British, Australian, Canadian – history, instructions, patterns, and excellent photographs

Kids Start Quilting – Alex Anderson, 2002, C&T Publishing – excellent guide, interesting designs

The New Sampler Quilt – Diana Leone, 1993 – good general reference

Quilt! Quilts!! Quilts!!! – The Complete Guide to Quiltmaking, 2nd edition, Diana McClun and Laure Nownes, 1997, The Quilt Digest Press – excellent reference to all aspects of making a quilt; contains complete instructions for 34 quilt patterns

101 Patchwork Designs – Ruby McKim, 1931, reprinted by Dover

Tessellation Quilts – Christine Porter, available from www.crizmac.com.

Pioneer/Westward Expansion

Eight Hands Round – a Patchwork Alphabet – Ann Whitford Paul, age 4-8, HarperCollins, 1996 – origins of 26 quilt patterns and designs, pioneer life in general

The Elephant Quilt – Stitch by Stitch to California – Susan Lowell, ages 4-8, Ferrar, Straus & Giroux, 2008 – a young girl makes a quilt as she and her family travel from Missouri to California in a covered wagon in 1859 (contains a map)

The Josefina Quilt Story – by Laurie Diamond and Eleanor Coerr, 1996, Learning Links, grades 1-3 (early chapter book) – a hen named Josefina saves the day on a wagon train bound for California, her young owner makes quilt blocks to tell the tale of the journey

Papa and the Pioneer Quilt – Jean Van Leeuwen, ages 4-8, Dial, 2007 – Family traveling via covered wagon from Missouri to Oregon on the Oregon Trail, reasons that quilts were made

The Quilt Block History of Pioneer Days – Mary Cobb, ages 4-8 (9-12, too), Millbrook Press, 1995 – appealing book, over 50 quilt blocks, simple and attractive crafts (no sewing required), pioneer life, map of wagon train trails

The Quilt Story – Tony Johnston, illustrated by Tomie DePaola, ages 4-8 – a pioneer girl and a modern girl both are comforted by the same quilt

The Seasons Sewn – a year in patchwork – Ann Whitford Paul, 1996, Voyager Books – History of quilt blocks as related to pioneer life, appealing woodblock illustrations and descriptions of daily life are accompanied by drawings of quilt blocks

Sewing Quilts – Ann Turner, 1994 – making quilts in a log cabin

Civil War

The Promise Quilt – Candice A. Ransom, ages 4-8, Walker Books for Young Readers, 2002 – Civil War, family values, sacrifice, coping, keeping promises – young Addie’s father promised to send her to school. After he dies in the Civil War, her mother makes a quilt using fabric from his shirt to raffle off to make money so that the school can buy supplies

Underground Railroad

Aunt Harriet’s Underground Railroad in the Sky – Faith Ringgold, ages 4-8, Dragonfly Books, 1995

Most-Loved in All the World – Tonya Cherie Hegamin, ages 4-8, Houghton Mifflin Books for Children, 2008 – a mother constructs a quilt to guide and comfort her daughter on her journey on the Underground Railroad, beautifully written and illustrated – “haunting, yet hopeful...” -

contains an educational author's note about the controversy of the connection of quilts and the Underground Railroad

The Patchwork Path: a Quilt Map to Freedom – Bettye Stroud, ages 4-8, Candlewick, 2007 (lovely drawings)

The Secret to Freedom– Marcia Vaughan, ages 4-8, Lee & Low Books, 2005

Sweet Clara and the Freedom Quilt - Deborah Hopkinson, ages 4-8, Dragonfly Books, 1998

Under the Quilt of Night – Deborah Hopkinson, Aladdin, 2005

Resource books for Underground Railroad and quilts

Facts and Fabrications – unraveling the history of quilts and slavery – 8 projects, 20 blocks, first-person accounts - Barbara Brackman, C&T Publishing, 2006 – thoroughly researched account; illustrated with many photos of slaves and former slaves; lots of history and first-person accounts from letters, diaries, and WPA interviews from the 1930's; discusses symbolism and poetic license as opposed to history. Excellent resource – enough information for a whole curriculum unit! **Includes instructions for adapting a sampler quilt for children to make, as well as a doll quilt (also for children to make).**

“Betsy Ross redux: The Underground Railroad ‘Quilt Code’” by Leigh Fellner, 2006 - download article at www.hartcottagequilts.com - thorough discussion of Underground Railroad connections as myth/hoax, as well as true stories of quilts in the Civil War (used to hide flags, etc.)

NOTE: Be aware that the book Hidden in Plain View, 1999, is not based on fact, but is often quoted.

Every artist knows the importance of symbolism in personal expression...your own poetic license doesn't give you rights to interpret another quilter's symbolism as history. You cannot use it to read a “map” into a nineteenth century Nine-Patch or interpret a Log Cabin Design as a code. Poetry is poetry; history is history. Mix the facts and fabrications in your own quilts if you like, but don't make the mistake of confusing fiction or myth for American history. – Barbara Brackman, Facts & Fabrications – unraveling the history of quilts and slavery

Miscellaneous Useful Things

The Quiltmaker's Gift – Jeff Brumbeau, Orchard Books/Scholastic, 2000 - a greedy king learns the joy of giving. Beautifully illustrated. Frontpiece and endpiece show and name 39 quilt blocks, including the cobweb block. There are 250 quilt patterns hidden in the illustrations, some via puns, e.g., Ocean waves = waves on a globe.

http://www.allcrafts.net/f.php?url=www.womenfolk.com/baby_quilts/american-girl-dolls.htm - American Girl doll quilts – patterns, directions, and history for several quilts

Bloom's Revised Taxonomy

Level of Thinking	What the Brain is Doing	Verbs Related to Thinking Level		Products Associated with Thinking Level	
Creating	Inventing	compose hypothesize design construct plan invent	originate develop role play produce create organize	article report game experiment book machine alternative course of action formulation of hypothesis	invention set of rules song play question set of standards survey
Evaluating	Judging	judge weigh support consider recommend compare	relate criticize evaluate critique appraise	valuing court trial conclusion self-evaluation recommendation evaluation standard compared standard established group	discussion survey
Analyzing	Breaking Down	analyze differentiate categorize distinguish select	classify point out compare survey infer	report argument questionnaire word defined parts of propaganda statement identified conclusion checked syllogism broken -down	graph survey
Applying	Using	organize dramatize produce sketch prepare generalize	show apply choose use solve paint	map forecast illustration question drama sculpture paper which follows an outline	project diagram solution list painting
Understanding	Connecting	match paraphrase summarize explain distinguish interrelate give example	restate rewrite illustrate defend extend interpret express	drama cartoon speech graph conclusion photograph own statement tape recording implication based on idea	skit story diagram model summary
Remembering	Storing	describe recognize locate state list	memorize identify recite select name	newspapers recordings text readings films/video filmstrips magazine articles television shows	events people radio plays



This reference and other resources are available at www.mpsaz.org/pillars

Mesa Public Schools

The Underground Railroad “Quilt Code” - FAQs

When people refer to the “Underground Railroad Quilt Code,” what do they mean?

A system of using quilts to help African-American slaves escape to freedom in the North or Canada during the first half of the 19th century. It first appeared in *Hidden in Plain View*, published in 1999.

What are Hidden in Plain View’s sources for the “Quilt Code” story?

The early 1990s claim of Ozella McDaniel Williams, an African-American woman who used the story to sell a quilt to a white woman in a tourist mall. The authors found no other evidence.

How is the “Quilt Code” said to have worked?

Claims keep changing, but as of January 2007 they involve variations on the following themes:

- ▶ **Mnemonic device** - to teach how to escape; each block said something different. Messages are either unhelpful to escape (“when you get free you can marry”) insultingly obvious (“head north”) or dangerous (“follow bear tracks to shelter and food”)
- ▶ **Messaging system** - displayed outside like a signal flag, often in strange places (from a cathedral tower at noon when bells rang indicated church was a safe refuge). Recently claimed that only the conductor could read the message, and then only if he knew the “African dialect” it used.
- ▶ **Map** - an actual map of the escape route, brought along on the escape. Knots tying the quilt together are claimed either to indicate a measure of time or distance, or latitude/longitude.
- ▶ **Award** - given as congratulatory gifts to slaves when they crossed the Canadian border.

What quilt blocks are said to have been included in this code, and what did they mean?

Too many to list; at last count at least 16 versions, including two contradictory accounts from Ozella and her nieces. All include blocks first introduced in the 1920s (Double Wedding Ring, Sunbonnet Sue, Dresden Plate) and the Log Cabin (which originated after Underground Railroad stopped operating). There are at least 7 different, conflicting claims about how the Log Cabin pattern was used.

What evidence is there that quilts were used in this way?

NONE.

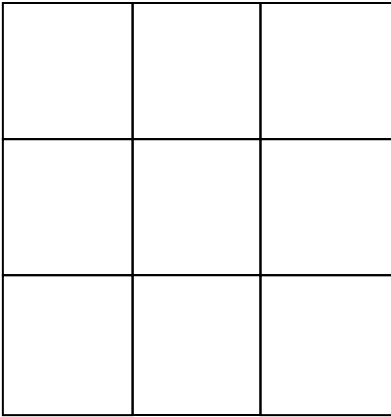
- ▶ Abolitionist and fugitive slave memoirs detail many other message systems; none uses quilts.
- ▶ The “Code” contradicts what historians *do* know about the UGRR and how slaves escaped to freedom.
- ▶ Ozella’s niece, who runs a for-profit “Quilt Code” museum and gift shop in Atlanta, claims to have a firsthand written account of the “Code”, but refuses to produce it. No “Code” quilt is known to exist.
- ▶ Ozella’s niece says Eliza Farrow, an African-born ancestor, developed and taught the “Code” as a married woman. Records show Eliza and her husband were born in northeast Georgia just a few years before the Civil War began. Ozella’s generation was the first to leave the South.

What quilt, Underground Railroad, and African-American historians believe a “Quilt Code” either did or could have existed?

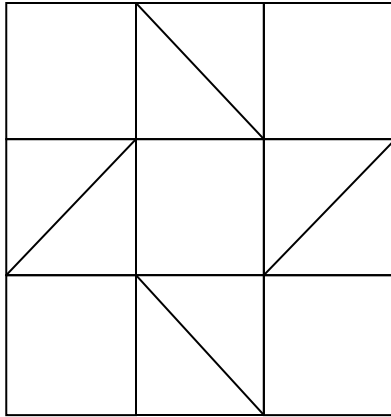
NONE. All describe it as a late 20th century myth, like Betsy Ross or George Washington and the cherry tree.

For more information on the “Quilt Code” myth, visit www.ugrrquilt.hartcottagequilts.com.

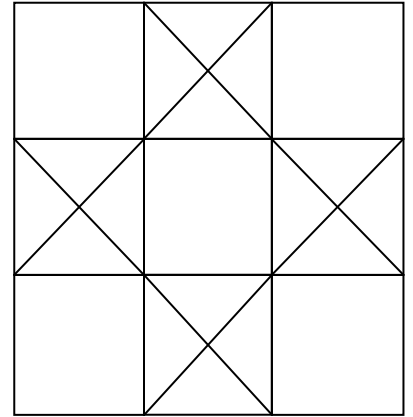
Quilt Blocks



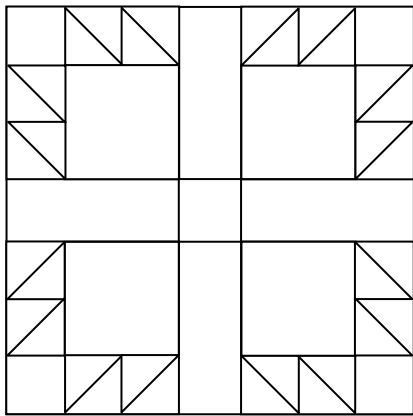
Nine Patch



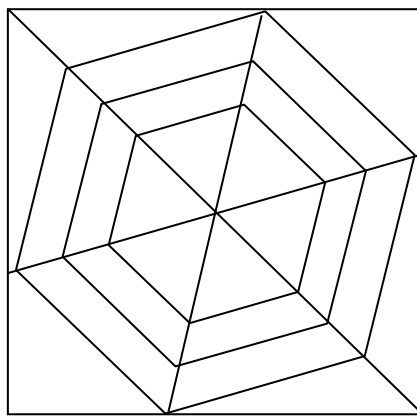
Friendship Star



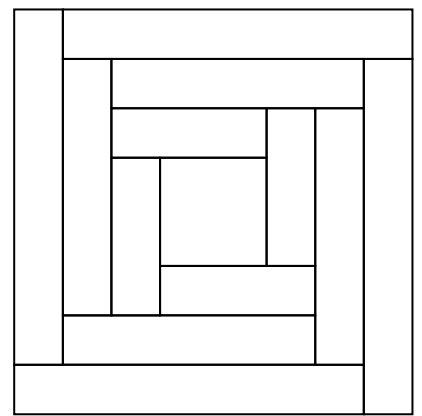
Ohio Star



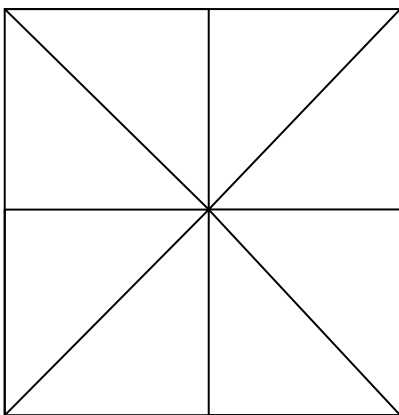
Bear's Paw



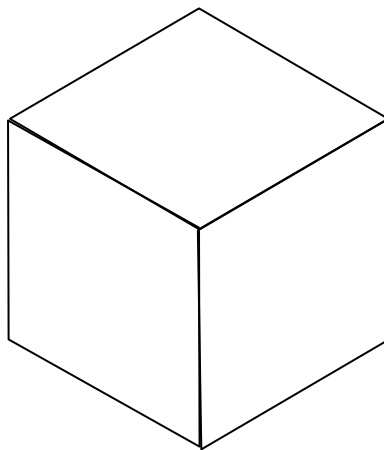
Cobweb



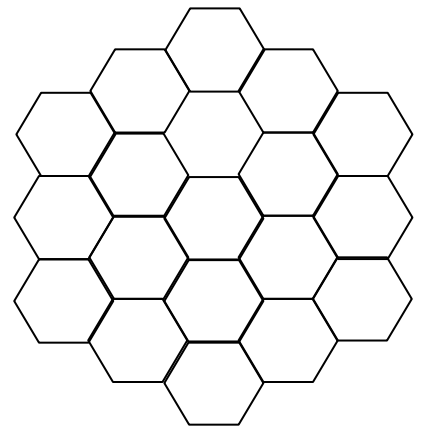
Log Cabin



Pin Wheel



Baby's Block



**Grandmother's
Flower Garden**