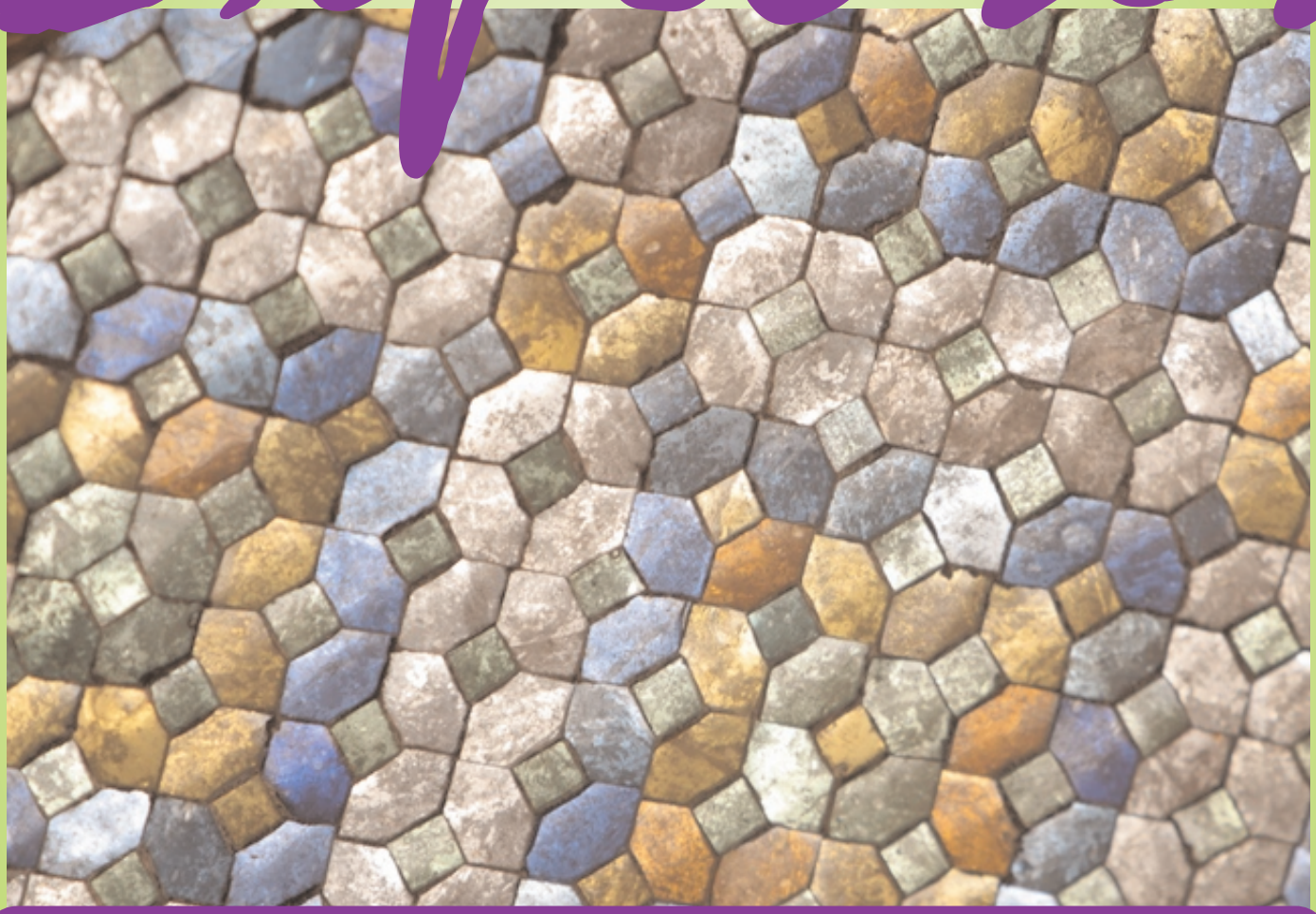
Math Explorer



MATHEMATICS AND QUILTING

Egyptians See Double

Sew Mathematically

Caroline Herschel, Astronomer and Mathematician

Vol. 8.3 Spring 2006

Math Explorer

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www.txstate.edu/mathworks
Math Explorer is published by
Texas State University
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Caroline Lucretia Herschel

by Jean Davis

Caroline Herschel was born in Germany on March 16, 1750. She was one of six children. Her mother did not think education was necessary for a girl and preferred that Caroline be a house servant to the family. Her father, however, wanted all of his children to be educated. Together they studied mathematics, French, and music. Her mother's opinion must have had great influence on Caroline because she spent most of her life in service to her brother William and later to her nephew John, both of whom were scientists. She took great pleasure in helping them with their work, and made many remarkable contributions of her own along the way, mostly in the field of astronomy.

When she was 3 years old, Caroline had smallpox, which left her face scarred. Then, at age ten, she had typhus, which stunted her growth. She was only 4 feet 3 inches tall. Because of the deformities caused by these illnesses, her parents decided she would never marry. She never did, but she did live to be 98 years old, and was in good health until the very end of her life.

At age 22 Caroline went to England to live with her brother William, who taught her mathematics and music. She had a beautiful voice and sang professionally all of her life. William's hobby was astronomy, the study of the stars. As Caroline helped him with his work, she began to learn more and more on her own. Together, she and her brother developed the modern mathematical approach to astronomy.

Nebulae are hazy clouds where stars form. Caroline discovered three new nebula in 1783. She was the first woman to discover a comet, and discovered a total of eight comets during her lifetime.
Her second comet is called Herschel-Rigollet, and returns every 155 years. Caroline catalogued every discovery she and William made. She kept incredibly accurate records of all their observations and also did the mathematical calculations. She did everything in such a careful and meticulous way that her records are still valuable today, over 200 years later.

In 1787, King George II gave Caroline a salary to be William's assistant. She became the first woman officially recognized for a scientific position. She received many awards and honors, including the Gold Medal for Science from the King of Prussia on her 96th birthday.

Caroline died on January 9, 1848. In 1889 a minor planet was named "Lucretia" in her honor. A crater on the moon is named the C. Herschel crater.

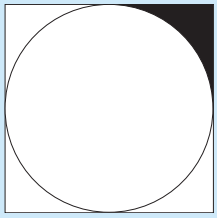
http://en.wikipedia.org/wiki/Caroline_Herschel
http://space.about.com/cs/astronomyhistory/a/herschelcar_2.htm

Jean Davis is on the mathematics faculty at Texas State University. She is particularly interested in the history of mathematics.

PROBLEMS PAGE

1. Josephine, August, and Hugo go running on Monday. Josephine runs every other day, August once every third day, and Hugo once every fifth day. On what day of the week do they run together next?

2. Find the area of the shaded region:



3. An object weighing 16 ounces is placed on the left pan of the balance scale. We have four weights available, one weighs 1 ounce, one weighs 3 ounces, one weighs 9 ounces and one weighs 27 ounces. How can we use these weights to balance the scale?

4. In how many different ways can 3 X's and 2 O's be placed in different squares of a 3 x 3 tic-tac-toe board, if the 3 X's must be in a line?

5. If **a** and **b** are positive integers and **ab** = 540, what is the smallest possible value of **a** + **b**?

6. What is the smallest positive integer that has 8 divisors? 12 divisors?

7. Find the next number in the sequence 6, 15, 35, 77, 143,....

8. A 12-unit ruler has no marks except one which is one unit from one end. Place three more marks on this ruler so that you can measure all the lengths 1-unit, 2-units, 3-units and so on to 12-units. See if you can find more than one way.

Answer: **1)** wednesday **2)** 1-π/4 **3)** 9 and 3 in left pan with the 16 and 1 and 27 in the right pan **4)** 120 **5)** 20 + 27 = 47 **6)** 24 and 60 **7)** 221 = 13 x 17

Is Quilting Mathematical?

by Shelly Sheats Harkness

Do you know someone who quilts? Have you ever considered that the quilter is also doing mathematics? The following is a true story about how my friend, Lisa Portwood, used mathematics to create a "reproduction" quilt.

Lisa is a member of the *American Quilt Study Group* (AQSG), a non-profit organization that focuses its efforts on preserving quilting heritage. She wanted to make a "reproduction quilt" similar to an original quilt and display it at the AQSG annual conference. In order to display as many quilts as possible within a limited amount of space, the AQSG required members to follow these guidelines:

Display: Must be accompanied by a color image of the original and a story about why the quilter selected this particular quilt to reproduce

Size: Maximum of 200 inches "measured around all four sides"

Color: Must be a "two-color" quilt from the period 1800-1940

The original quilt that Lisa wanted to reproduce and display belonged to her neighbor; it measured 88 inches on one side. Before she started to sew, she needed answers to these questions:

Figure 1: Reproduction Quilt (left) and the Original Quilt (right)

1. By what percent would she reduce the original quilt to fit the "200 inches" guideline?

2. How much white fabric did she need to buy for the front and back of the quilt? (Please note: Fabric on rolls measures 44-45 inches wide and is bought by the yard and/or fractions of yards. White fabric is underneath the blue pieces.)

3. How much blue fabric did she need to buy for the appliqué designs, borders, and binding (or edges)?

These questions were not so easy to answer. At first, Lisa tried to find a scale factor to use so that the original quilt,

which had a perimeter of 352 inches, could be "reduced" to a perimeter of 200 inches. What would you do? (We suggest you answer this question before you read more.)

When she used proportions, Lisa found that the perimeter of the reproduction quilt had to be about 57% of the perimeter of the original quilt. However, because the guidelines said it could be no larger than 200 inches she reduced the perimeter by a scale factor of 50% - a friendly number! This meant that each side of her reproduction quilt measured 44 inches. Was she within the guidelines? Did she break any rule?

Lisa wanted to buy the least amount of white fabric possible (remember that fabric can only be purchased in lengths that are 44-45 inches wide). She sketched a plan on graph paper. How much white fabric do you think she bought?

She traced the blue pattern pieces from the original quilt (Figure 2), put them on the copy machine, and entered 50% into the machine. Using the reduced images and a ruler, she estimated the amount of fabric needed for the blue part.

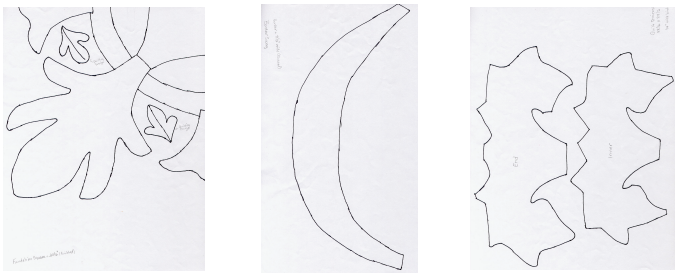


Figure 2: Templates for blue pattern pieces

When Lisa "reduced" the perimeter by 50%, something surprising happened to the area of the quilt. How did the 50% reduction in the perimeter affect the area of the reproduction quilt as compared to the original quilt? (Try this yourself: Draw a square or rectangle on a piece of paper, put it on a copy machine, enter a 50% scale factor, copy it and see what happens.)

About how many reproduction quilts can be displayed in the place of one original quilt (see Figure 1)? Why does this happen? This is a big idea in mathematics. How the perimeter and area are related when something is reduced or enlarged is not so straightforward.

After Lisa finished her reproduction quilt, she took a picture of it hanging next the original quilt. She saw mathematics - symmetry! What kinds of symmetry do you see in the original and Lisa's reproduction quilt? How do you know?

After answering all of these questions, have you reconsidered whether or not you think that quilters do mathematics?

Shelly Sheats Harkness is an Assistant Professor in Secondary Education-Mathematics at the University of Cincinnati. She is interested in connections between mathematics and art, mathematics and social justice, and Ethnomathematics.

Lisa Portwood is a self-taught quiltmaker, quilt historian and writer. She is also a Senior Administrative Secretary at Miami University in the Teacher Education Department. She has been quilting for 20 years.

Puzzle Page

Math Explorers: We want to print your work! Send your original math games, puzzles, problems, and activities to:
Texas Mathworks, 601 University Dr., San Marcos, TX 78666

Suppose you have 12 coins and one is counterfeit. The counterfeit coin is either heavier or lighter than a real coin. Can you find the counterfeit coin and determine if it is heavier or lighter, in only three weighs on a balance scale?

Fill in the corners with 4 even numbers so that the total is 45 in each row, column and diagonal.

	3	
9	15	21
	27	

Word Search

Forwards or backwards, up, slanted, or down. Where can the words in this puzzle be found?

Comet
Enlarge
Quilt
Double
Nebula
Reproduce
Duplication
Proportion
Symmetry

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

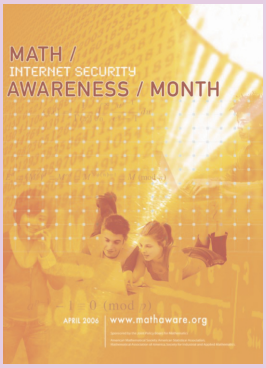
How many ways can a rook move on a chessboard from the lower left corner to the upper right corner if each move can only be up, left or right and you cannot enter any squares more than once?

Bulletin Board

It's all about NUMB3RS

Can mathematics help solve crimes? Find out on "NUMB3RS", a Friday night television show. Check your local listings for time information. You can get a head start on related mathematics activities by visiting: http://www.nctm.org/news/2005_09numb3rs.htm.

April was Math Awareness Month



The theme of the 2006 Math Awareness Month was Mathematics and Internet Security. Mathematics and computer technology are woven together in the design of our electronic communication system that we call internet. Visit: *http://www.mathaware.org/mam/06/* to learn more about this topic and to get ideas about how you and your school can celebrate Mathematics in April and all year long!

Math Chuckles!

What did one math book say to the other?

Don't bother me, I have my own problems!!

What is MathNerds?

MathNerds provides free, discovery-based, mathematical guidance via an international volunteer network of mathematicians.

MathNerds does not supply answers to homework, take home tests or the like; rather, they provide hints, suggestions, and references to help clients understand and solve their mathematical problems.

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Egyptian Multiplication

Writings that give us a glimpse into Egyptian arithmetic of 2000 BC and before are found on the Rhind Papyrus written by an Egyptian scribe named Ahmes around 1650 BC. Found near Thebes, Egypt and named after the owner, a Scotsman named A. Henry Rhind, it contains writings that appear to be mathematical exercises including some that involve multiplication and division.

The Egyptian method of multiplying two numbers was by successively doubling one of the numbers and then adding the appropriate duplications to form the product.

Consider the following example: Find the product of 23 and 62.
Let's start by making a chart of the multiples of 62.

1	62
2	124
4	248
8	496
16	992

We stop doubling because we want only twenty-three 62's and the next doubling, 32, would be larger than 23. Notice that 23 = 1 + 2 + 4 + 16, so we indicate the partial products that we need to add:

1	62 *
2	124*
4	248*
8	496
16	992*
23	1426

We conclude that 23(62) = (1 + 2 + 4 + 16)62 = 62 + 124 + 248 + 992 = 1426.

Try using this method of multiplying by doubling and summing to find the product of 19 and 27.

Dear *Math Explorers*,

April was Math Awareness Month. We hope all of you had an opportunity to share your interest in mathematics with others in your family, school, and community. Our mayor recently read a proclamation declaring Math Awareness Month in the city of San Marcos. Visit our website to read the proclamation.

Our main article features the connection of mathematics to quilting. Geometry and measurement can be found in variety of settings of which sewing is one. We hope you will enjoy the biography about the fascinating life of Caroline Herschel as well as attempt the challenging problems and puzzles. Let us hear from you with your solutions.

Sincerely,

Hiroko K. Warshauer

Hiroko K. Warshauer, Executive Editor