Math Explorer

MATH & ART

Art Upon Reflection

Julia Robinson Tackles Hilbert!!

Geometry Transforms

Vol. 3.4 Summer 2001

Math Explorer

Contents

Math Explorer
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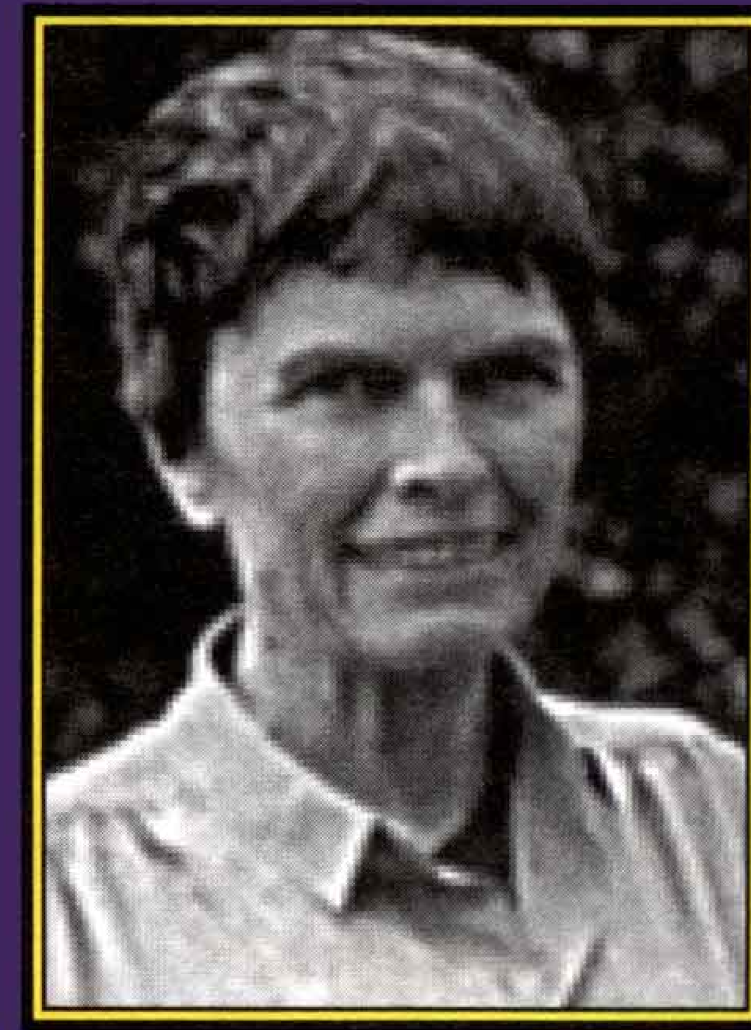
SWT

Julia Bowman Robinson



Hiroko K. Warshauer

One of last century's most outstanding mathematicians, Julia Bowman Robinson, was born on December 8, 1919 in St. Louis, Missouri. When her mother died when she was only two years old, Julia and her older sister, Constance, went to live with their grandmother in Phoenix, Arizona until their father remarried and moved the family to San Diego, California.

At nine years of age, Julia came down with scarlet fever, a very contagious disease, and the entire family had to be quarantined (isolated from other people to prevent the spread of the disease). A year later, Julia came down with rheumatic fever, another serious disease, which forced her into isolation from even her family. Despite her illnesses, Julia studied diligently with a tutor and re-entered school in the 9th grade with a keen interest in mathematics.

Julia found a suitable environment for doing mathematical research at the University of California at Berkeley, where she earned her Ph.D. in 1948. She also met and married Raphael Robinson, a mathematician who was teaching at Berkeley. Julia went on to work on many mathematical problems, including her contribution to the solution of Hilbert's 10th Problem. The 10th Problem is one of the numbered problems posed by the famous mathematician David Hilbert, and it deals with Diophantine Equations.

During her lifetime, Julia received recognition for her many outstanding achievements, which included becoming the first woman mathematician to be elected to the National Academy of Science, the first woman president of the American Mathematical Society, and receiving the MacArthur Fellowship. However, all the attention embarrassed Julia. She wrote, "All the attention has been gratifying but also embarrassing. What I really am is a mathematician. Rather than being remembered as the first woman of this or that, I would prefer to be remembered as a mathematician should, simply for the theorems I have proved and the problems I have solved." Julia Robinson died of cancer in 1985.

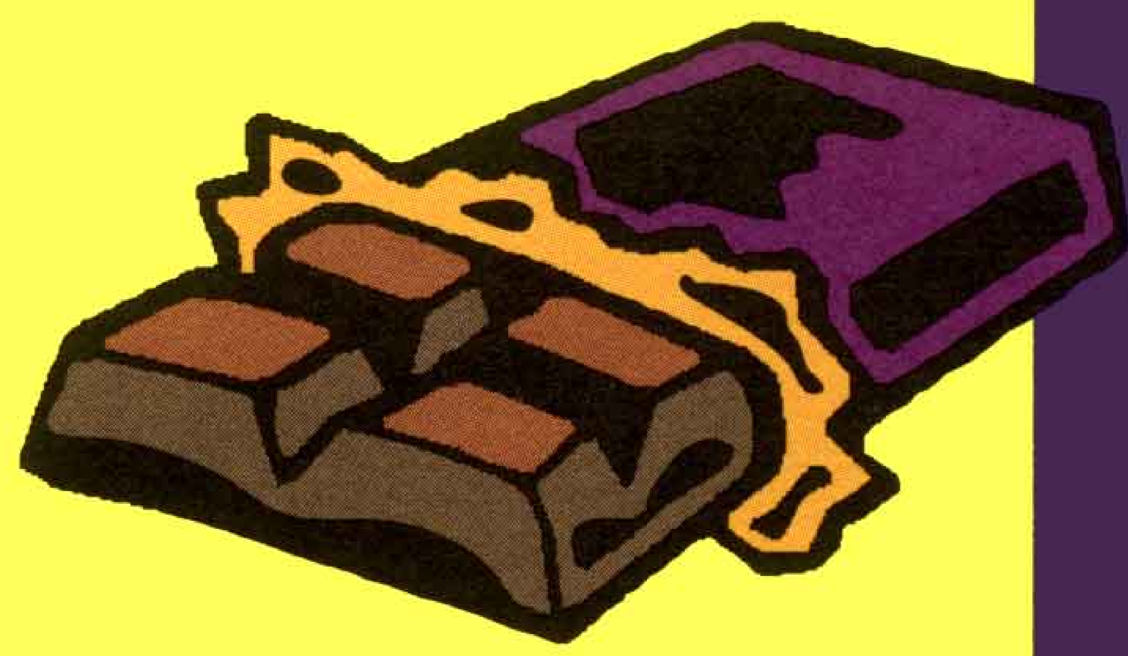
Reference: http://www.agnesscott.edu/lriddle/women/robinson.html
http: www-history.mcs.st-andrews.ac.uk/history/Mathematicians/Robinson_Julia.html

Hiroko K. Warshauer teaches mathematics at Southwest Texas State University.

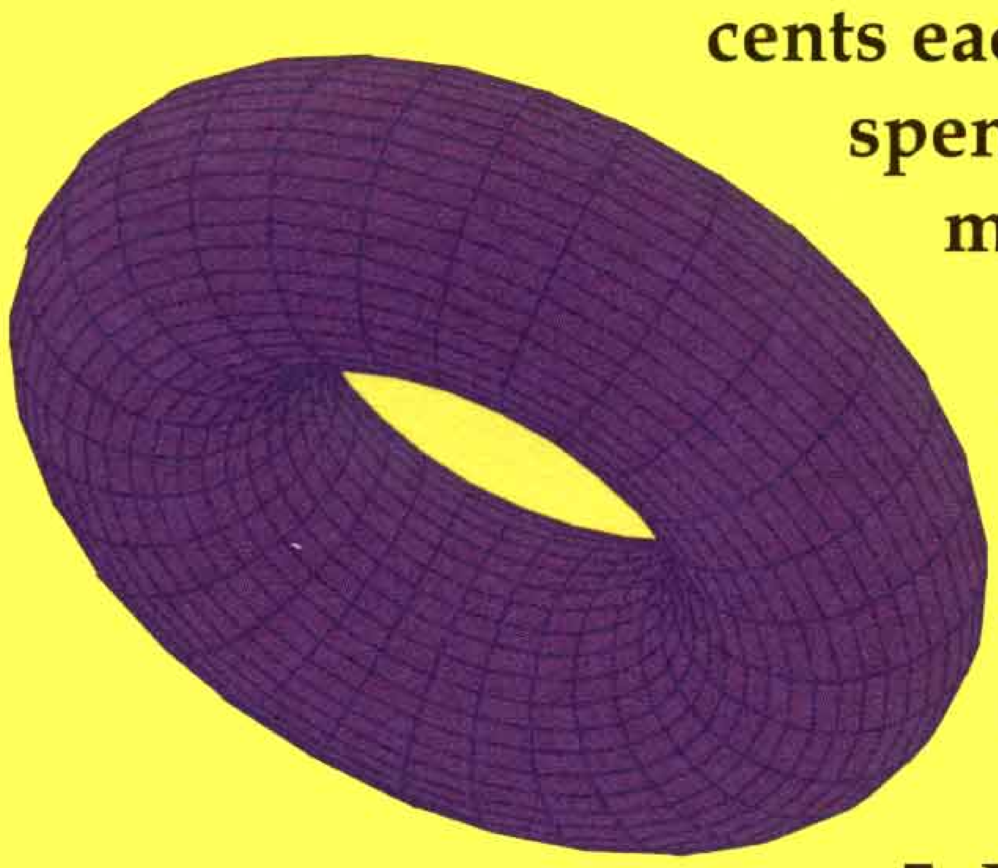
PROBLEMS OF THE MONTH

1. How many numbers between 1 and 1000 have exactly one zero?

2. Create two rectangles, so that the area of the first is larger than the area of the second, but the perimeter of the first is smaller than the perimeter of the second.



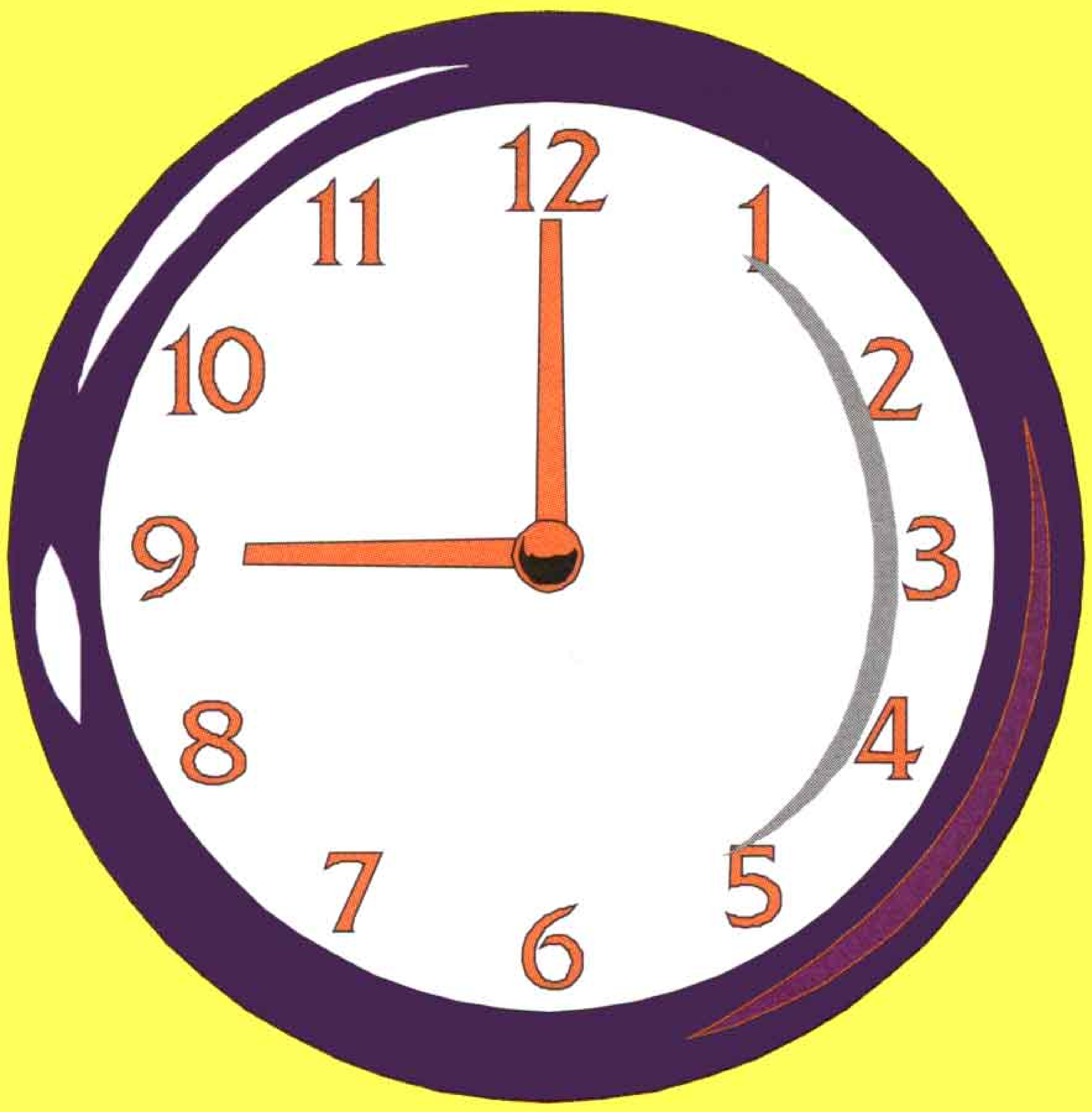
3. Yoshi bought some candy bars and sodas. The candy bars cost 50 cents each and the sodas cost 60 cents each. He spent $3.20. How many candy bars and how many sodas did he buy?



4. The price of a CD player was $100 at the end of 1998. The price increased 10% in 1999 and the price decreased 10% in 2000. How much does the CD player cost now?

5. Draw two circles on a torus (donut surface) in such a way that if you cut the torus with scissors along both circles, you would still get only one piece.

6. How many zeros are at the end of $4^{100} \times 5^{175}$?

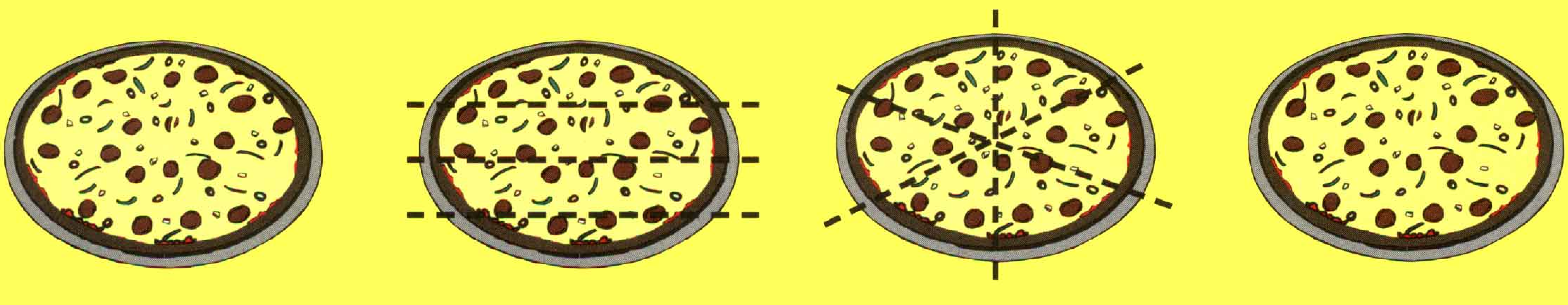


7. At 9:00 the hour hand and the minute hand form a right angle. How often in a 12 hour period does this happen?

8. A fast-food chain offers 5-piece chicken strip and 9-piece chicken strip packages.
How is it possible to buy exactly 32 pieces?
How about exactly 31 pieces?

9. Find a triangle where the number of inches in the perimeter equals the number of square inches in the area.

10. A pizza cutter can cut a pizza into 4 or 6 pieces with 3 cuts, as in the diagram below. How can the pizza be cut into 5 pieces with 3 cuts? How about 7 pieces?



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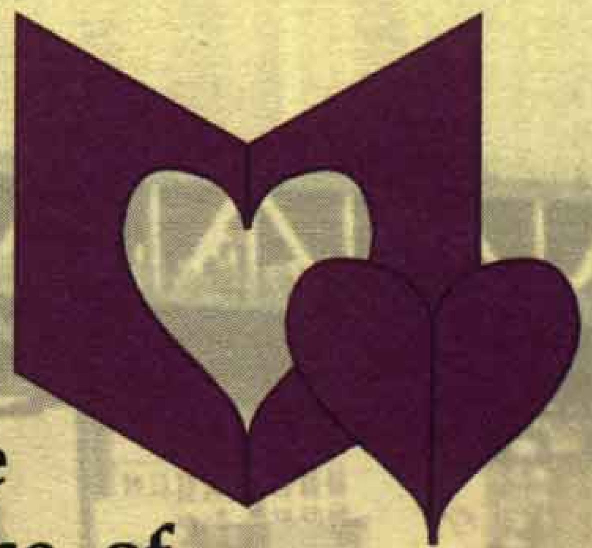
The Beauty of Art and Mathematics

by Joyce Fischer

Artists usually begin a work by having an inspiration. Sometimes they visually imagine the composition as a finished product, and sometimes they have a general topic or idea to begin with that gradually grows through a long creative process. For most artists, a conscious connection between mathematics and art never enters into the production of a work of art. But, in the final analysis, however, art does contain mathematics.

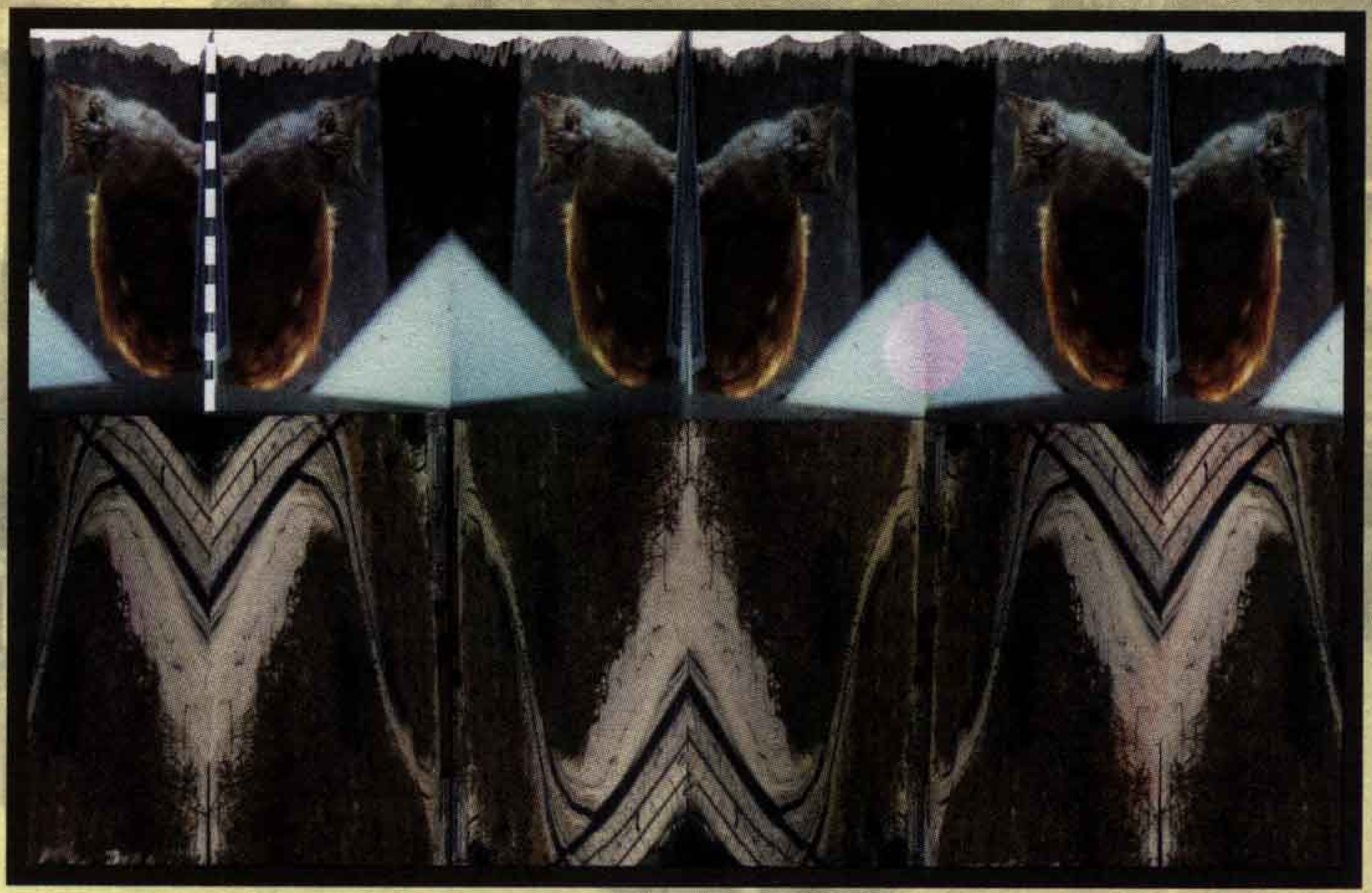
Linda Kelsey-Jones is an artist who lives in San Marcos, Texas, and creates beautiful works of art, called photo collages, that can be viewed anew using a type of mathematics known as *transformational geometry*. To the eyes of a mathematician, the large works housed at the San Marcos Public Library contain a noticeable use of reflection, one of the basic forms of transformational geometry.

For an everyday example of a *reflection*, look into a mirror or a clear pool of water and observe the reflected image. Another way to envision this concept is to try to imagine a line that starts at the top of your head and travels down the middle of your body all the way to the ground beneath your feet. The right side of your body should look like the left side of your body reflected cross this line. Most humans are not perfect examples, but come very close to the ideal.



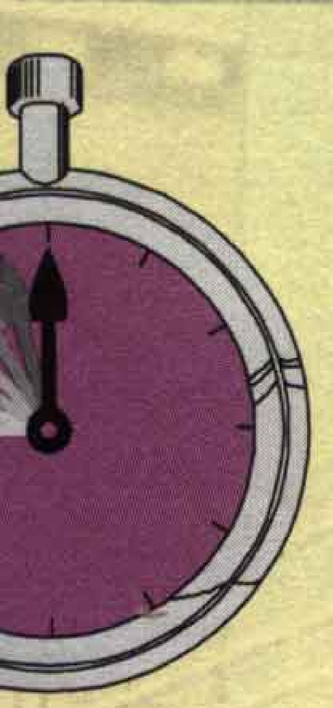
Another way to see an example of reflection is to fold a piece of paper in half and cut out any shape along the fold. When you open the paper again, each half contains the exact same size and shape and the fold line separates the shape into two equal halves.

We've drawn in a line of reflection in Ms. Kelsey-Jones art work. Can you find other lines that would work?



Another way to think about reflections is by measuring the distance, point by point, from the line of reflection. For each point on one side of the line there should be a point on the other side of the line the same distance from the line.

Another facet of transformational geometry evident in Ms. Kelsey-Jones work is *rotation*. This concept involves a point, an object some distance from that point, and an angle. If you



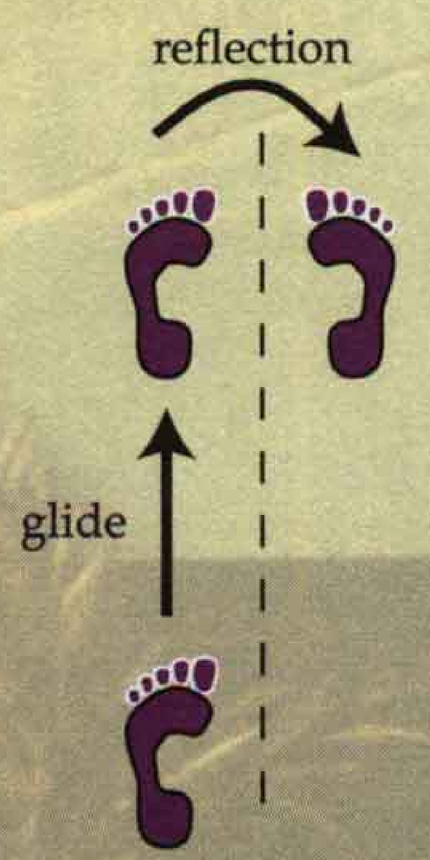
think of a stopwatch with a secondhand, the center of the stopwatch would be the point of rotation, and the second hand would be the object. If you start at zero and let the watch run for 15 seconds, the angle of rotation would be 90 degrees.

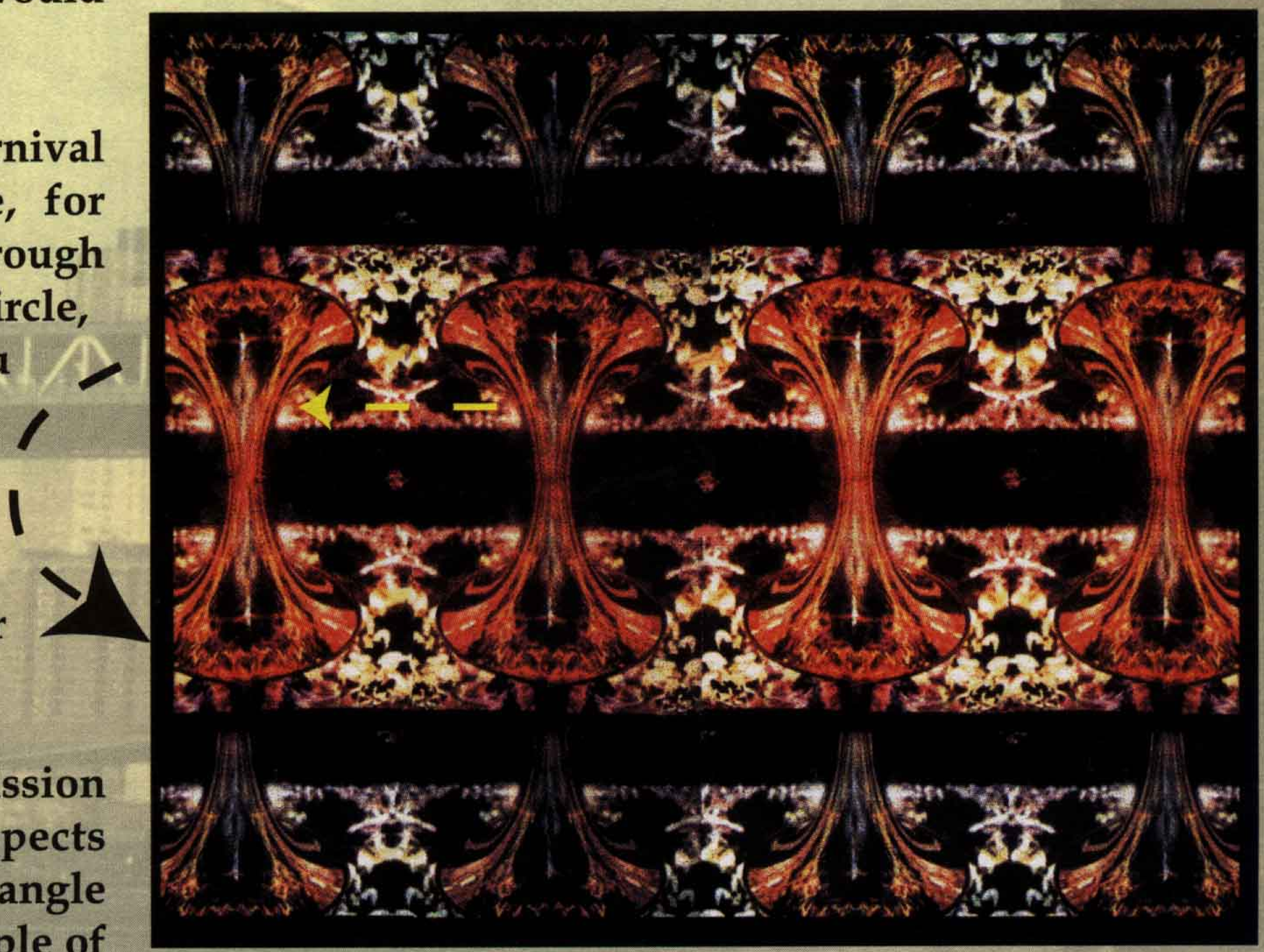
Another everyday example is a carnival ride. On a merry-go-round horse, for instance, you and the horse rotate through all angles up to 360 degrees, or one circle, putting you back exactly where you started. Then you begin rotating through the angles again. The planets orbiting around the sun also are examples of objects (for example, earth) rotating about a fixed point (our sun).

Ms. Kelsey-Jones has given us permission to discover the rotational aspects embedded in her art. A line and an angle are drawn in to help you see an example of the rotation. Can you see other rotations in the collage that are not marked?

The angel rode a white horse

Let's take a brief look at a third form of transformational geometry called *glide-reflection*. Recall the line from the top of your head through the middle of your body to the ground beneath your feet. If you move your left foot straight ahead, then you have created a glide-reflection. The glide part is the distance you moved your foot along a straight line. The reflection part is our left foot compared to your right foot. See if you can spot some glide-reflections in the works of Ms. Kelsey-Jones.





One important feature of each of these geometric concepts is that regardless of the object that is reflected, rotated, or glide-reflected, the size of the object remains the same. Mathematicians call this ability to maintain size while being moved about an *isometry*.

By using geometry, Ms. Kelsey-Jones creates patterns that integrate the separate parts into a new integrated pattern. Ms. Kelsey-Jones says, "Even with the most mundane of things, there is beauty when you reflect upon it and find the unifying pattern. It is a kind of visual music."

After examining Ms. Kelsey-Jones' works, we can see that her collages contain the beauty of art merged silently with the beauty of mathematics.

Joyce Fischer teaches in the Department of Mathematics at Southwest Texas State University. Her research concerns the relationship between logical reasoning and students' learning of mathematical concepts.

Puzzle Page

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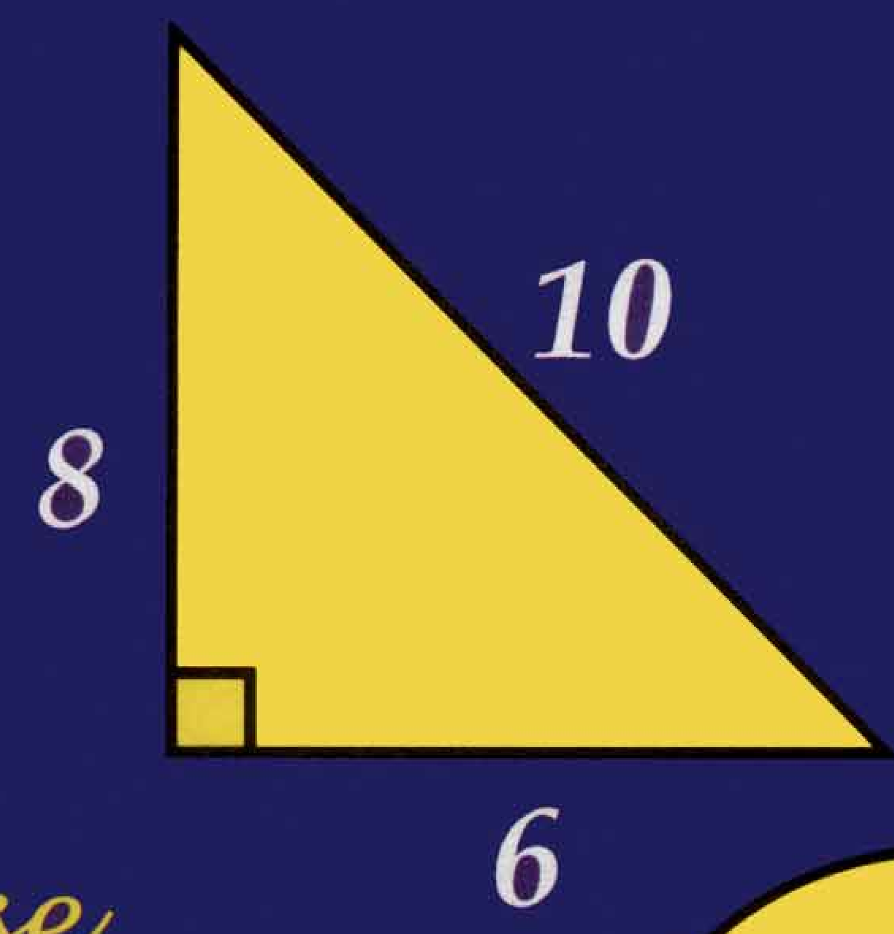
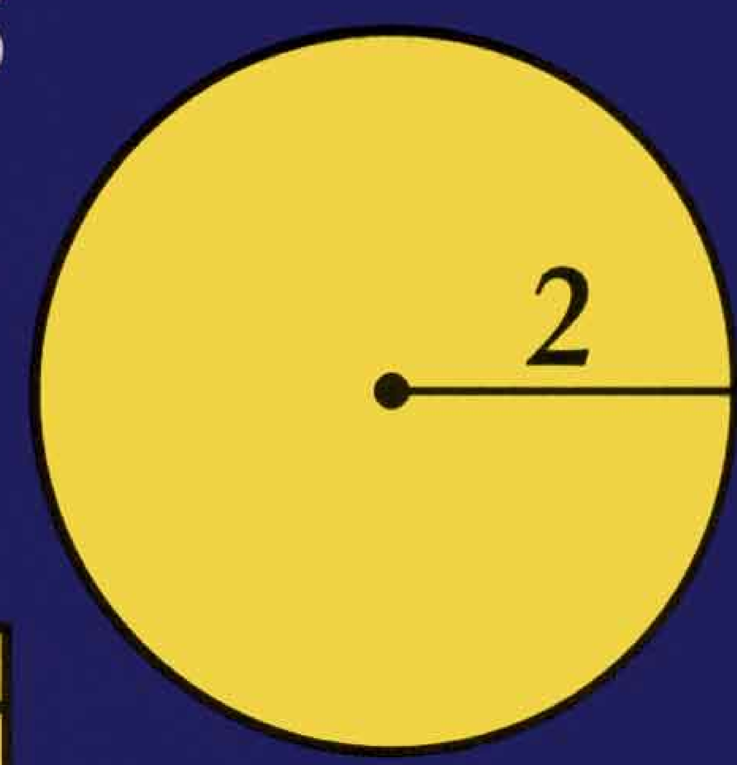
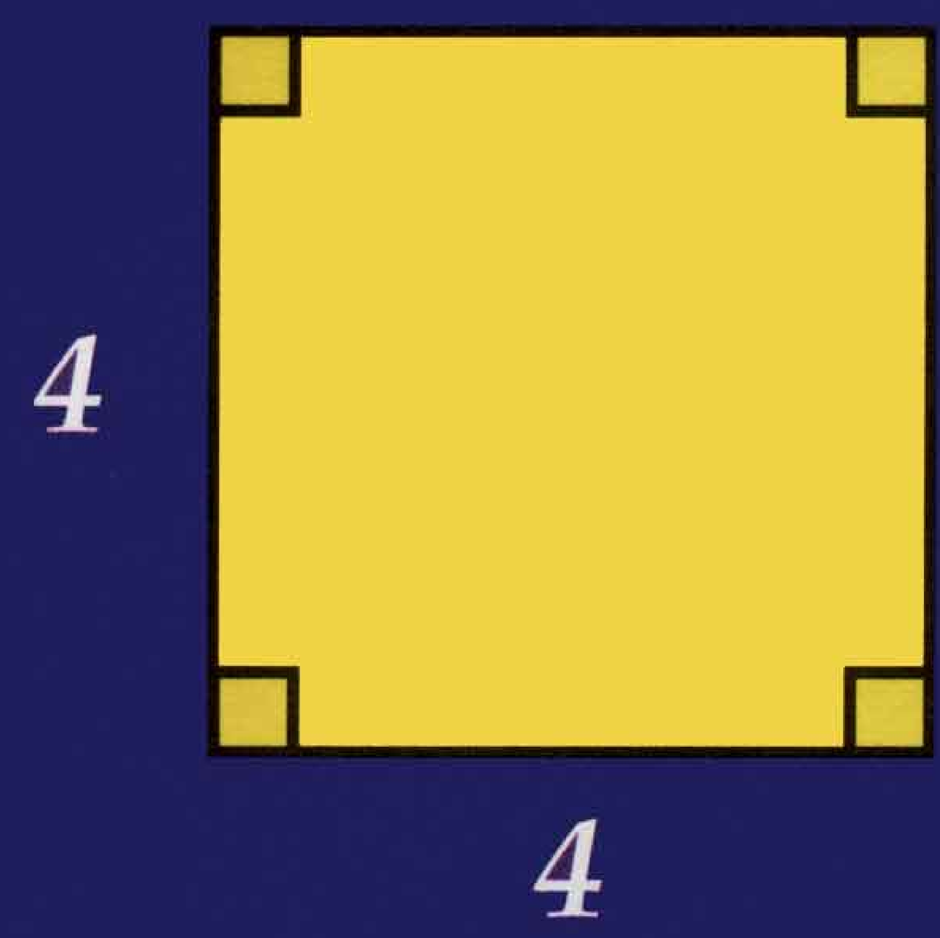
Becky catches 100 fish, marks them, and then returns them to the lake where she was fishing. The next week, she catches 100 fish and finds that 12 were already marked. How many fish (approximately) are in the lake?

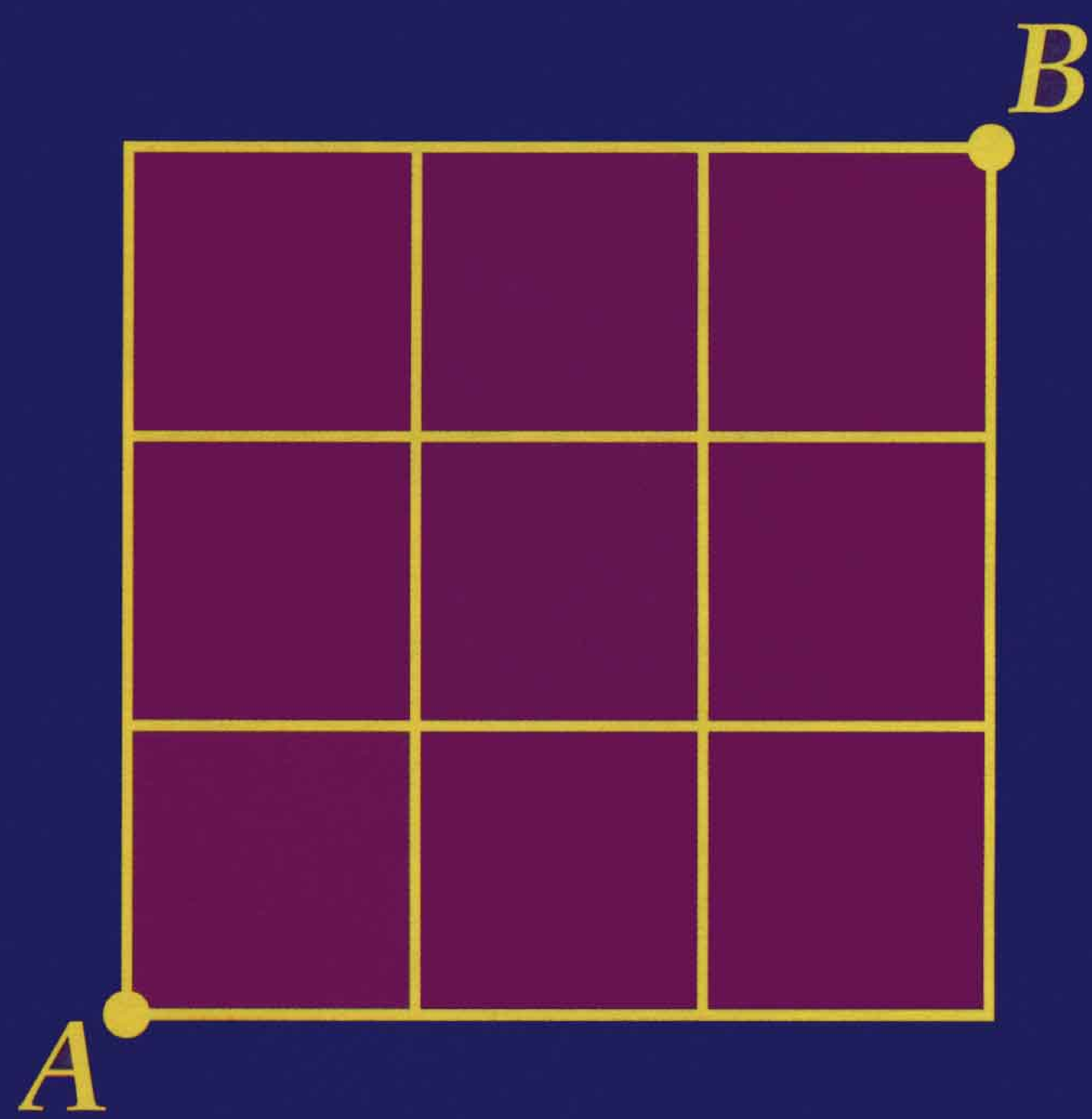


What do these shapes have in common?





How many ways can Jacob walk from point A to point B assuming every step is either up or to the right?



Bulletin Board

Math Camps Everywhere!

SWT Math Camps are opening all over: Austin, Port Lavaca, McAllen, Mission, Rio Grande City, Edinburg, Progreso, Donna, Hidalgo, Zapata, Mercedes, La Joya and even in California! For more information about attending or beginning a new program, call or contact Max Warshauer at 512-245-3439 or e-mail max@swt.edu

Check It Out

For tons of information on various math related topics check out **http://webmath.com**

And for some Math Baseball try **http://www.funbrain.com**

Words of Wisdom

In studying the procedures of geometric thought, we may hope to reach what is the most essential in the human mind.

-- Henri Poincare

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Did you know?

Triskaidekaphobia is the fear of the number 13, such as Friday the 13th.

Did you hear this?

If two is company and three is a crowd, what are four and five?

Nine

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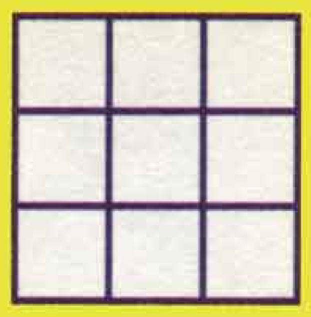
MATH ODYSSEY

by Jean Davis

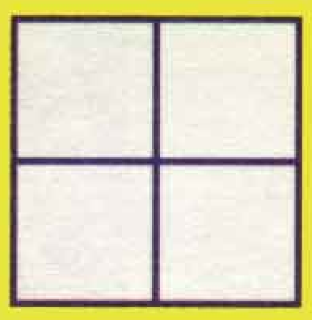
Was Your Grandmother a Mathematician?

Quilts - the literal fabric of Americana. Your grandma pieced together bits of fabric from long worn out clothing to make a security blanket to keep you warm and preserve your memories. Hardly the stuff of which mathematics is made. Right? Wrong! The jargon of quilting is packed with mathematical terminology. Pattern orientation, symmetry, rotation, quarter-inch allowances, graph paper, true grids, half-square triangle (What?!), fat quarter cut and 45° angle mitred seam. The intricate geometry in the beautiful designs is deceptive. A pretty design, yes, but oh so much more. Let's take a closer look.

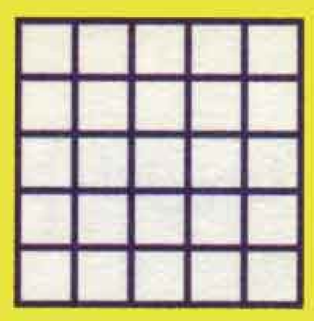
A quilt is made up of smaller sections called *blocks*. A block is made up of yet smaller sections called *patches*. Most traditional quilt block patterns will fall into one of the following categories:



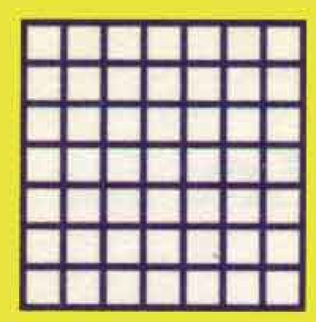
Nine Patch Blocks
6″, 12″ & 18″ Quilt Blocks



Four Patch
6″, 12″ & 18″ Quilt Blocks



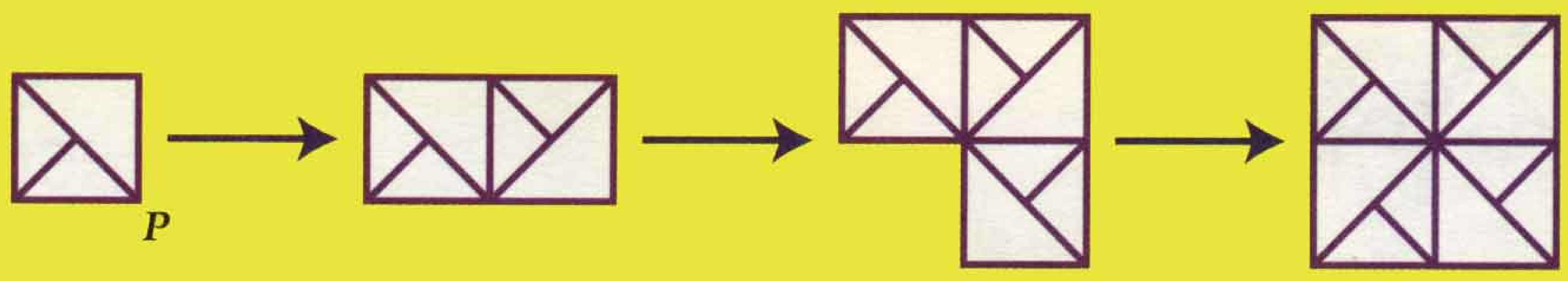
Five Patch
10″ Quilt Blocks



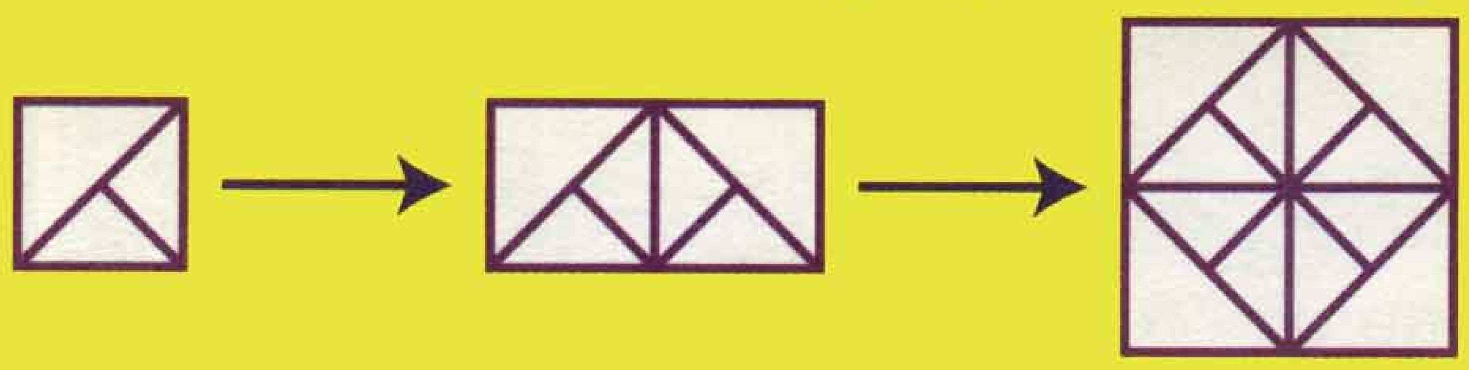
Seven Patch Block
14″ Quilt Blocks

A quilt can look very different depending on how the patches are arranged to form the block. Suppose we start with a very simple patch:

Form a block by *rotating* 90° about P.

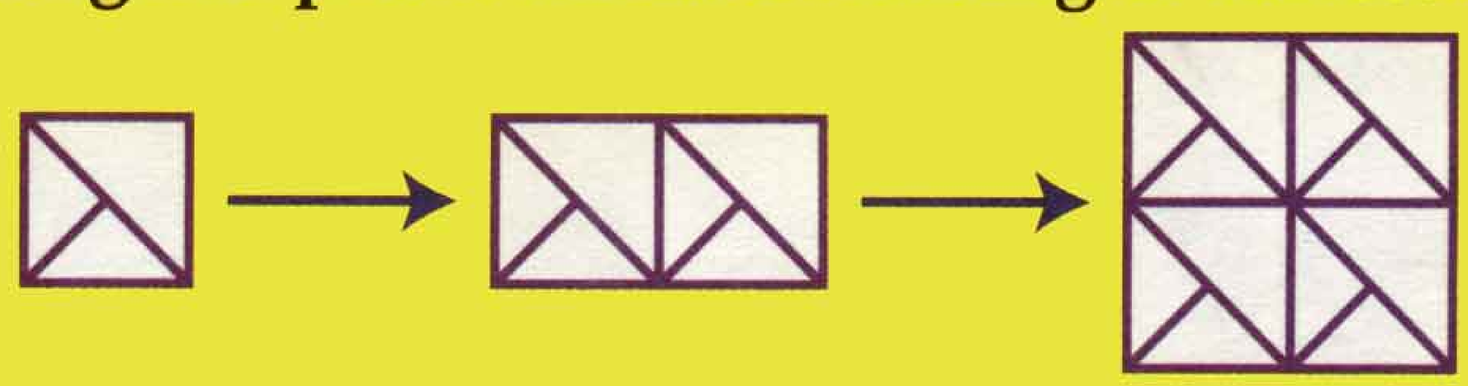


Starting with the same patch, this time form the block by *reflecting* the patch first vertically, then horizontally. (More math words!)



Still another patch can be formed by *translating* the original patch without rotating or reflecting.

An interesting question: How many different quilt tops can be formed from one patch?



References: www.quilting.about.com
mail.kosmickitty.com
quiltchannel.com

Jean Davis teaches mathematics at Southwest Texas State University.

In this issue of *Math Explorer*, we explore the visual and underlying connections between art and mathematics. In the summer months ahead, you too can use your imagination, creativity and mathematics to make your own works of art.

Let us know what you liked in this year's magazines. We'll have more fun puzzles and problems to challenge you in the fall issue. We hope you will subscribe to another year of math exploration!

Sincerely,

Hiroko K. Warshauer

Hiroko K. Warshauer, editor