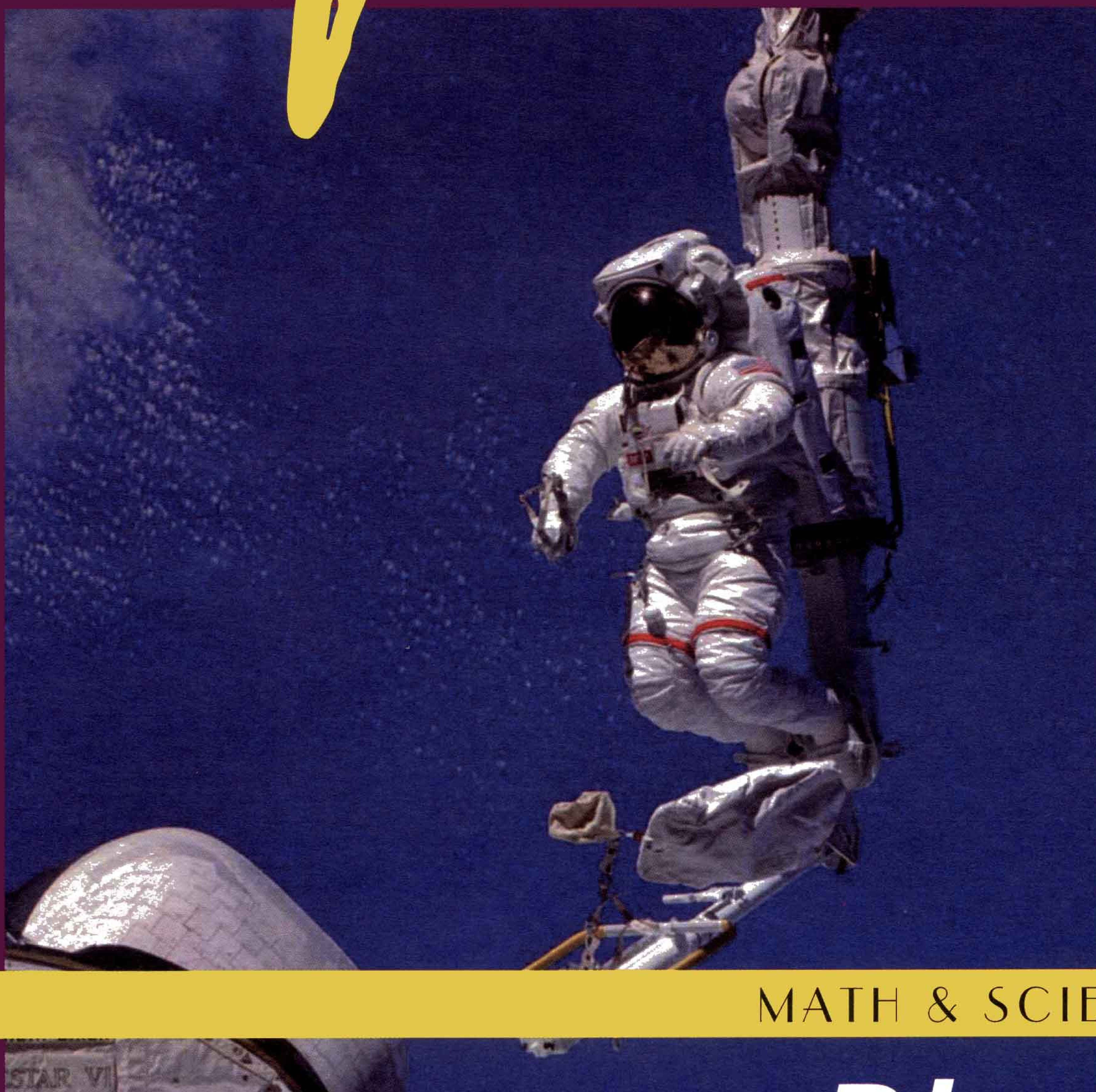
Math Explorer



MATH & SCIENCE

A Pi toss!

Vanishing Leprechauns?

The Beaker speaks volumes !!!

Vol. 2.6 March 2000

Math Explorer

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Math Explorer

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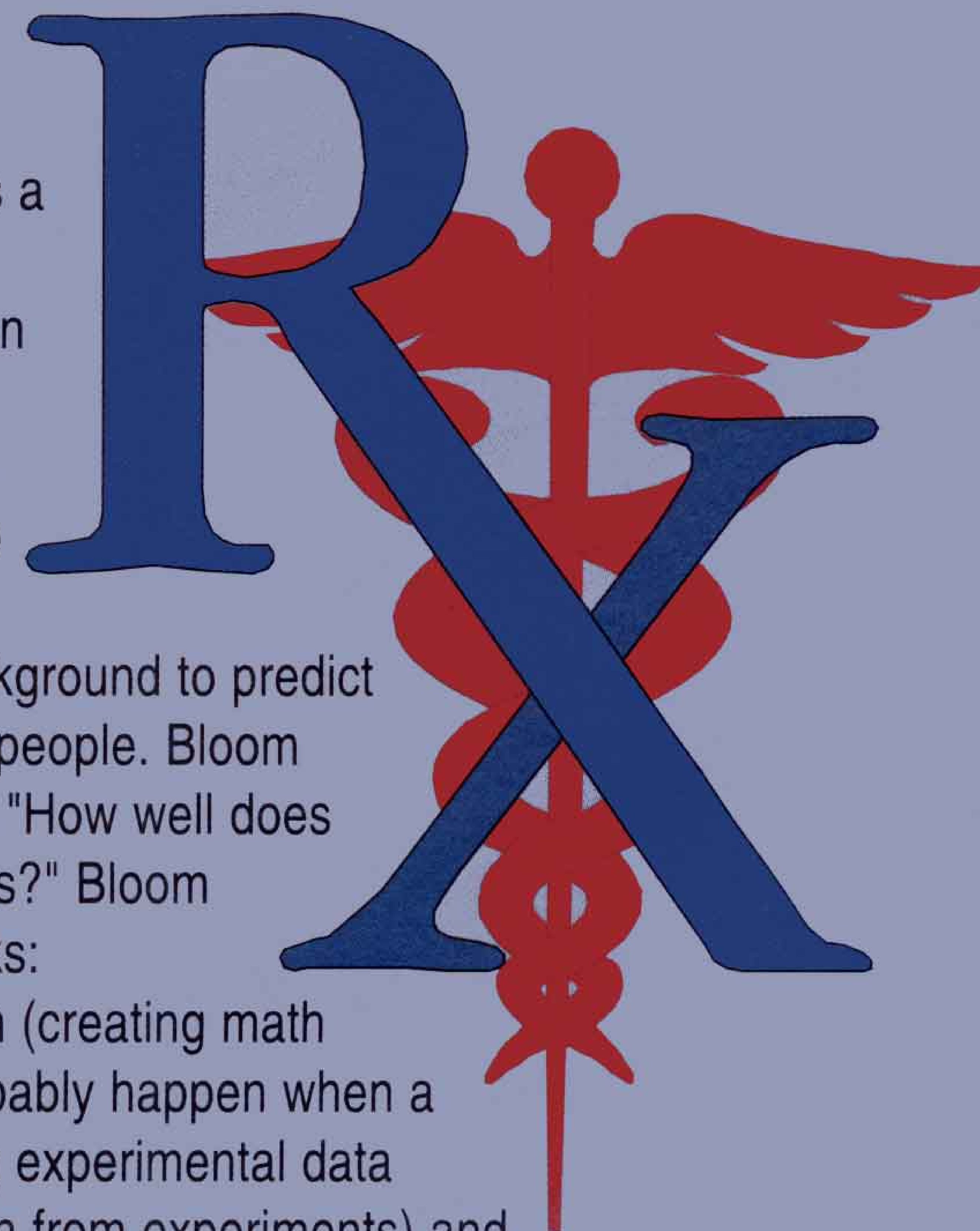
SWT

Laura Bloom



Laura Bloom is a cancer researcher and mathematician at Aguron Pharmaceuticals, a company that produces medicine to help people with serious diseases. She uses her math background to predict how drugs will work on people. Bloom asks questions such as "How well does this drug kill cancer cells?" Bloom does three kinds of tasks: mathematical simulation (creating math models of what will probably happen when a drug is used), analyzing experimental data (studying the information from experiments) and statistical support (for example, figuring how many cells a drug kills in an experiment).

Bloom says she is working in an area that has not used math much in the past except for statistics. She is often told she is on the cutting edge, thus she expects there will be more mathematicians like her in the future. Bloom was educated to be a research mathematician. She has a degree in mathematics from the University of Pennsylvania and a doctorate from the University of California at San Diego.

When Bloom was hired, her boss told her it was because he could not find any biologists with the right math skills. He had decided it would be easier to teach her biology than to teach a biologist advanced math. Bloom says: "I use my mathematical training all the time...The perspective I bring to problems we are trying to solve is radically different from that of my colleagues [co-workers]."

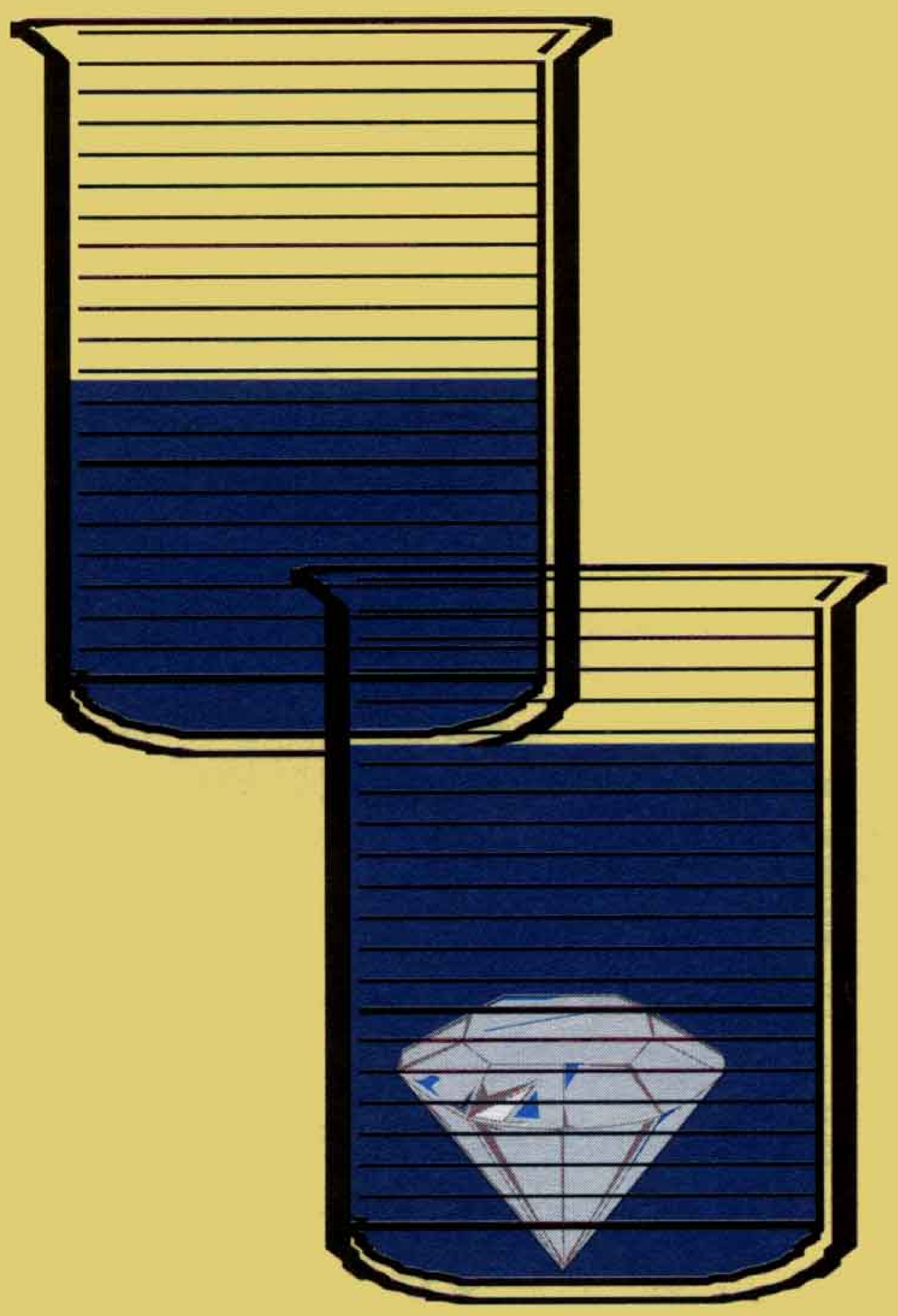
Bloom says she loves her job because she can use her mathematical training to do the important work of finding anti-cancer drugs. See if you can make a list of different careers and how they use math.

Source:
http://www.ams.org/egi-bin/careers/bin/view.pl/live/Laura_Bloom

by Laura Chavkin, who attends Yale University, and Hiroko Warshauer, who teaches mathematics at Southwest Texas State University.

PROBLEMS OF THE MONTH

1. Make up an experiment to measure and compare how far a dropped ball will fall during the 1st second, 2nd second and possibly the 3rd second. Would it help if the ball was rolling down a straight inclined board (with sides)? Why?



2. A page is torn from a book of not more than 70 pages. The sum of the remaining page numbers is 1200. What is the sum of the two page numbers on each side of the page torn out?

3. How would you measure the volume of an oddly-shaped object? Select several odd shaped objects and try to measure their volumes. (Hint: Choose objects that can get wet and put them in a beaker full of water.)

4. How many different ways can the number 55 be written as the sum of two prime numbers?

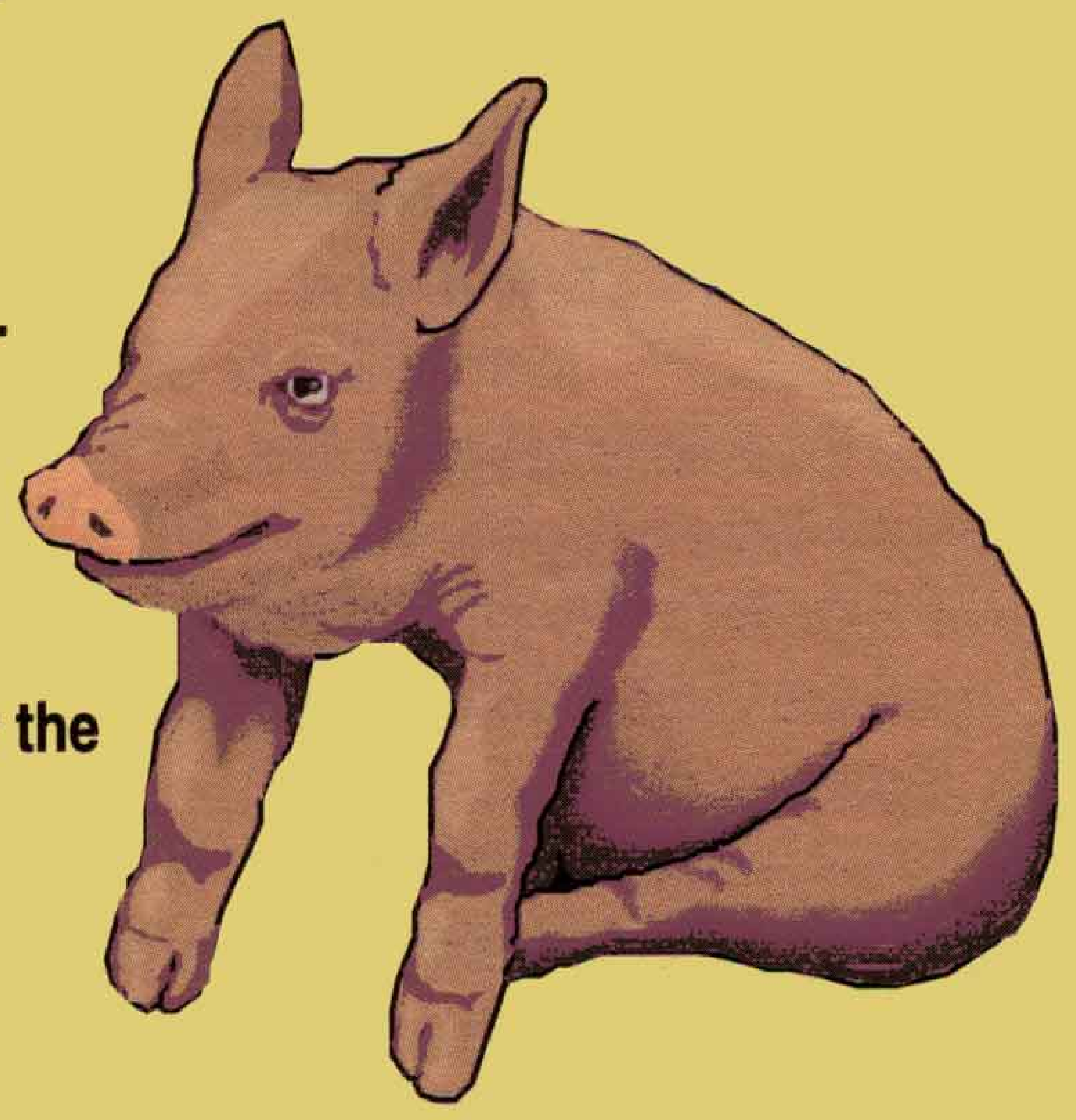
5. Find numbers a and b such that (a-b)(a)(a+b) is a prime number.

6. John said his age now is the square of what it was 6 years ago. What is his age now?

7. A plane in space is like a flat piece of paper that continues infinitely in each direction. Into how many regions is space divided by three planes intersecting at one point? Can you visualize this problem by using the walls in the room you are in, thinking of each wall as a plane? (You will have to imagine the walls continuing in each direction.) Into how many regions is space divided by the six planes which are formed by the sides of a cube?

8. What is the 2000th number in the following sequence?
1, -2, 2, -3, 3, -3, 4, -4, 4, -4, 5, -5, 5, -5, 5, -6, 6, -6, 6, -6, 6, ...

9. **INGENUITY:** A farmer wants to build a rectangular pig pen against a long straight wall. She will only need to build a fence on 3 sides. If she has 100 feet of fencing, experiment to see what lengths of the 3 sides will give her the greatest possible area. (Make a guess first.)



Send us your solutions! Every month, we will publish the best solutions on our website: www.mathexplorer.com. If we print your solutions, we will send you and your teacher free *Math Explorer* pens!

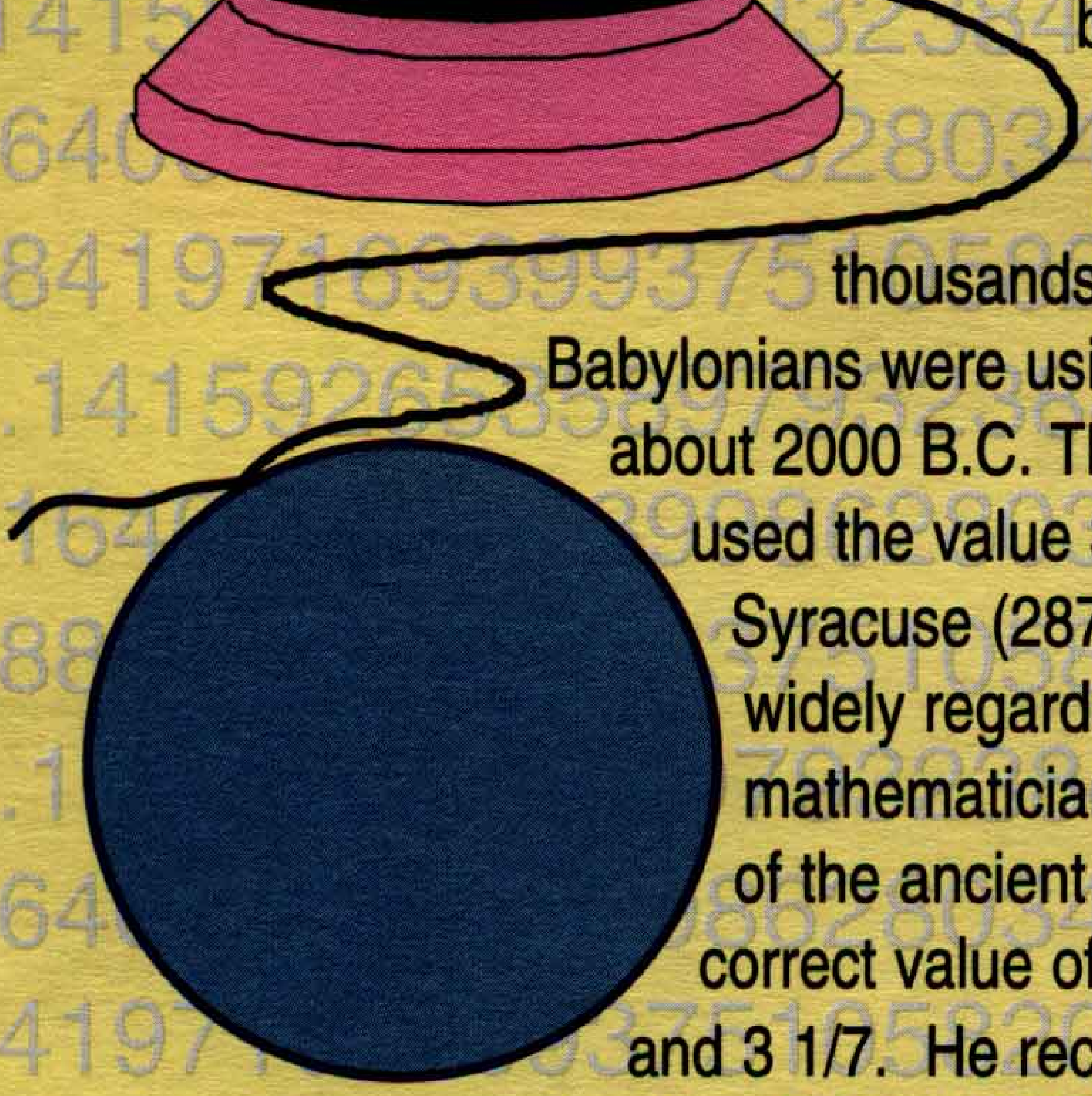
A Science Exp

by Eugene Curtin

What is the number π (pi)? Here is how to calculate π.
Step 1: Measure the circumference of a circle.
Step 2: Measure its diameter.
Step 3: Divide the circumference by the diameter.
The answer you get is the number π.

What number do you get? Well I just tried it with the lid of my coffee mug. I needed about 28.8 centimeters of thread to wrap around the circumference, and about 9.4 centimeters to stretch across the diameter.

28.8 centimeters/9.4 centimeters=3.06 (approximately).



If you had a perfectly shaped circle and could measure the circumference and diameter exactly, the ratio would be the number π. However, exact measurement is not possible in the real world. How do you find, then, the true value of π?

People have been fascinated by this number and how to find good approximations of it for thousands of years. The Babylonians were using the value 3 1/8 in about 2000 B.C. The ancient Egyptians used the value 3 13/81. Archimedes of Syracuse (287 B.C-212 B.C.), who is widely regarded as the greatest mathematician, scientist and engineer of the ancient world, proved that the correct value of π is between 3 10/71 and 3 1/7. He recommended the use of the approximation 3 1/7 = 22/7 in practical work.

This approximation is still often used today and is

3.14159265358979323846264338327

sometimes referred to as the Archimedean value. In the eighteenth century mathematicians proved that π is irrational. This means that no matter what two whole numbers A and B you take, A/B can never equal π, although it could of course be a good approximation. Using sophisticated mathematical techniques, modern computers can find π to literally billions of decimal places. In 1997 scientists at the University of Tokyo computed 51,539,600,000 decimal places of π. Above in blue is π with only the first 100 decimal places.

One of the most entertaining ways to approach π is known as Buffon's needle experiment. Suppose you have the floor marked off with thin parallel lines. Repeatedly throw a needle whose length is equal to the distance between the lines. Each time check if the needle is crossing one of the lines when it lands. It can be shown that for a large number of throws, that

$$2 \times \frac{\text{Number of Throws}}{\text{Number of Crossings}}$$

will probably give a good approximation for π. The reason this formula works is because the longer the needle, the greater the probability of having crossings. Mathematically, we say that the number of crossings is proportional to the length of the object being tossed.

Let's listen to Maria and the professor discuss a science experiment for finding π:

Maria comes across the professor throwing odd shaped wires onto a mat marked off with thin equally spaced lines, peering at the wires, and writing numbers in her notebook.

Maria: What crazy scheme are you working on now, Professor?
Professor: I'm looking for π.
Maria: There is some pie in the cafeteria, but it is not very good.

eriment for Pi

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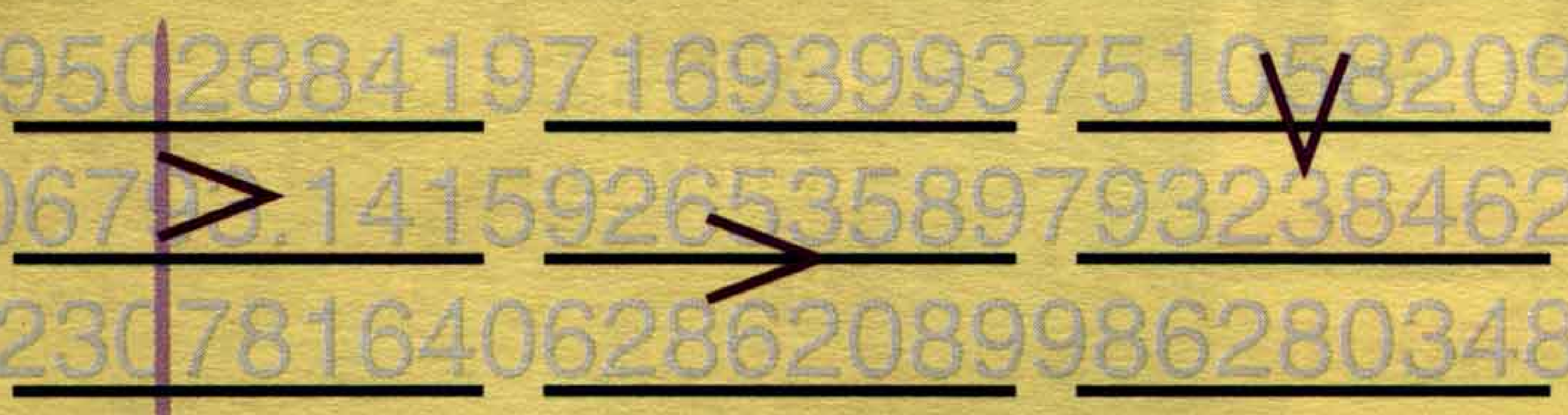
Professor: Hmmm! I think that the number of times a wire crosses a line divided by the number of times I throw the wire is in the long run proportional to the length of the wire, and has nothing to do with the shape.
Maria: I don't think so Prof. If you take a straight wire it is more likely to cross a line than if I bend it into a V,



but it still has the same total length.
Professor: Very true! But if you bend it into a V it is more likely to cross the same line twice, and I am counting that as two crossings!

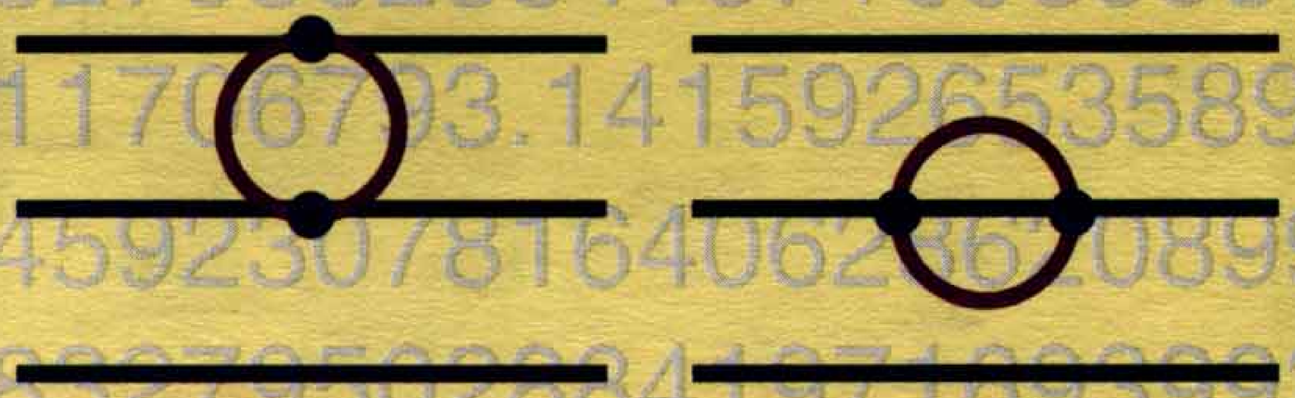
The professor and Maria throw a straight wire 20 times, and count a total of 13 crossings. They then bend it into a V, throw 20 times and count 11 crossings.

Maria: 11/20 is not the same as 13/20.
Professor: That is true, but I'm talking about long term averages. If I toss a fair coin, I expect it will come up heads about 1/2 the time in the long run. If I toss it 20 times I might get 12 heads or 9 heads or some such number. If I toss it 1000 times it is very unlikely I will get exactly 500 heads, but I expect that the number of heads divided by 1000 will be very close to 1/2.

Maria and the professor experiment with the same wire in different shapes, a W, a C, an S shape, and most of the time the number of crossings divided by the number of throws is close to 3/5. They repeat this with a wire twice as long and get crossings/throws equal to around 6/5 most of the time.

Maria: Is the theory working out?
Professor: I will have to do a lot more throws to see if I get more accurate results.

Maria: And someone is going to give you some pie for this?
Professor: Suppose I throw a wire which is bent into a perfect circle with diameter exactly equal to the line spacing. What will happen?

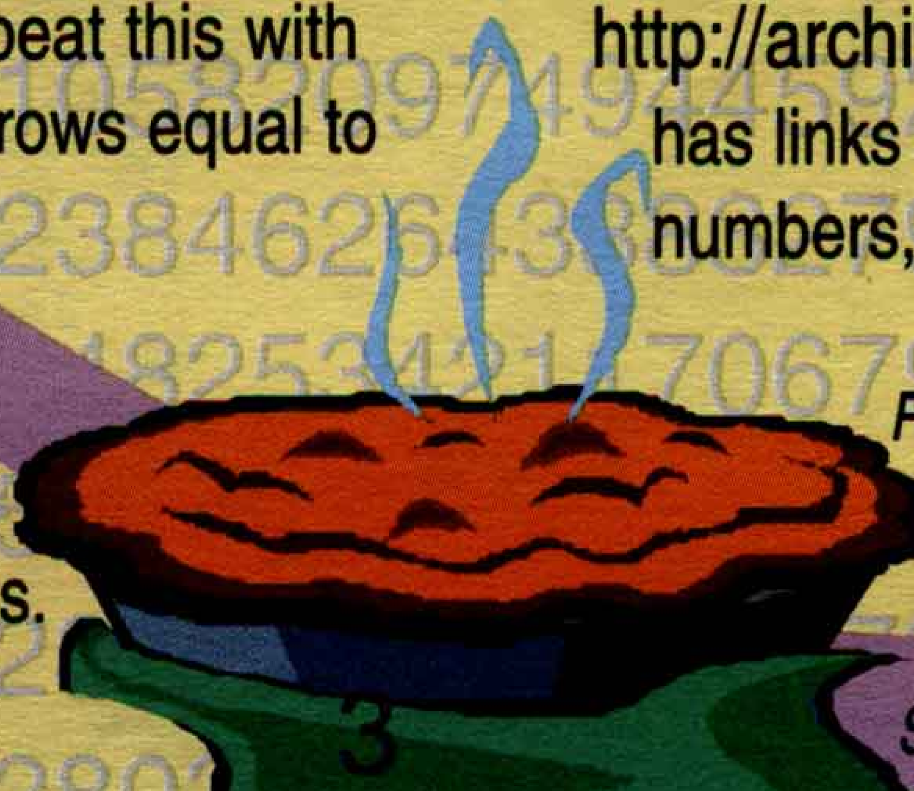


Maria: The circle will cross one line twice, or maybe it falls exactly in the space between two lines touching them both once. Either way we record two crossings.
Professor: Excellent! And if I throw it 100 times I must get 200 crossings. No need to do it.
Maria: Yes, your fraction for this wire is 2 no matter what.
Professor Good, now let's do it with a straight wire which is a diameter of that circle.

Maria and the Prof did 100 throws, getting 62 crossings.

Maria: We get a fraction 62/100, or .62. And the circle is pi times as long as the diameter, so its fraction should be pi x .62.
Professor Yes, but we said that we get 2 for the circle.
Maria: Oh yes. So pi x .62=2, and so pi=2/.62.
Professor: Well, that's close enough for today. Let's go get some pie, Maria!

Do you want to know more about π or other fascinating numbers in mathematics? The web page: http://archives.math.utk.edu/subjects/numbers.html has links to lots of interesting pages devoted to the numbers, including several sites devoted to π alone.



Reference: A History of Pi, by Petr Beckmann, 1971, The Golem Press.

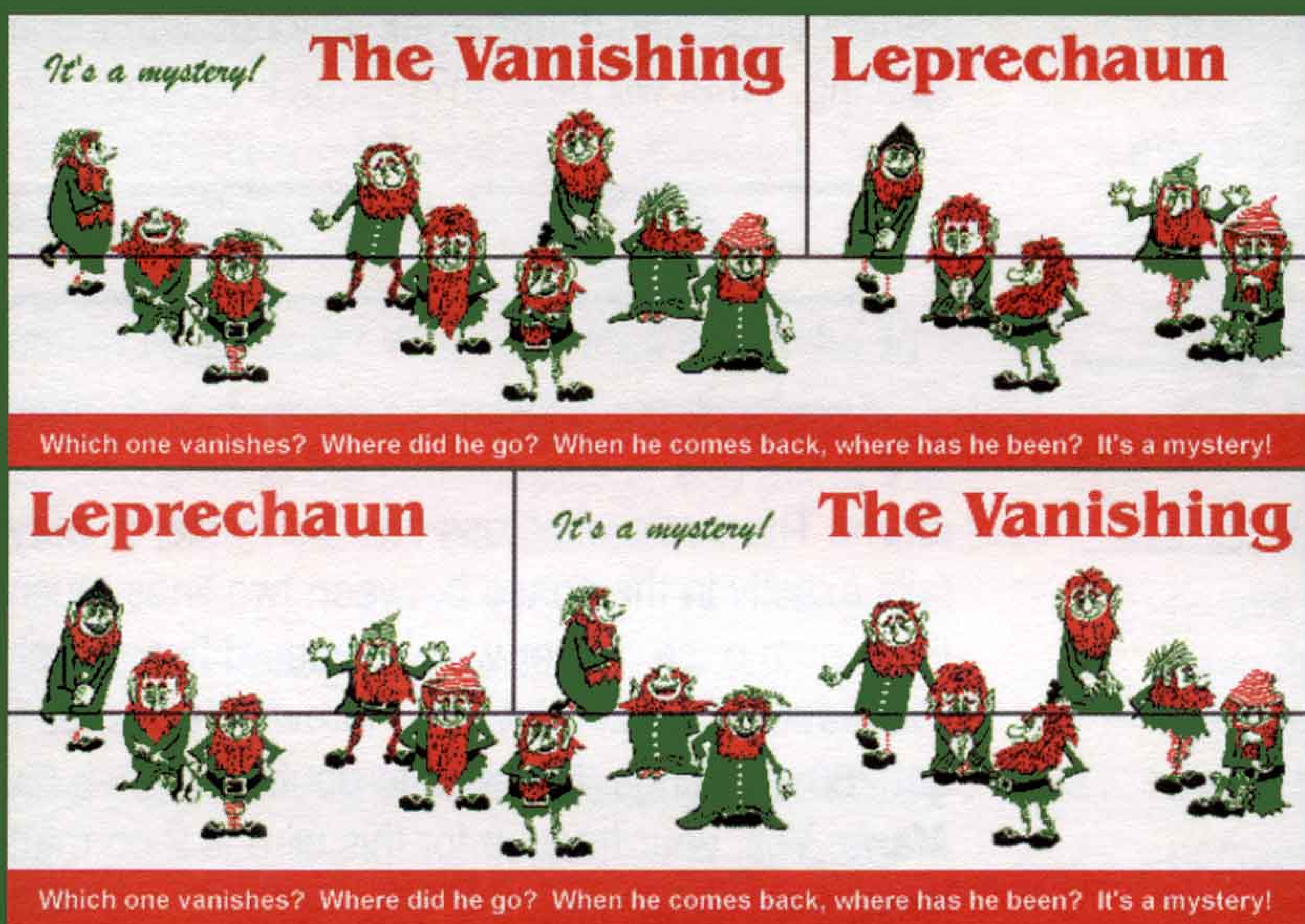
The author, Eugene Curtin, teaches mathematics at Southwest Texas State University; and is a past chess champion of Ireland.

Puzzle Page

Math Explorers:

We want to print your work! Send us original math games, puzzles, problems, and activities. If we print them, we'll send you and your math teacher free *Math Explorer* pens.

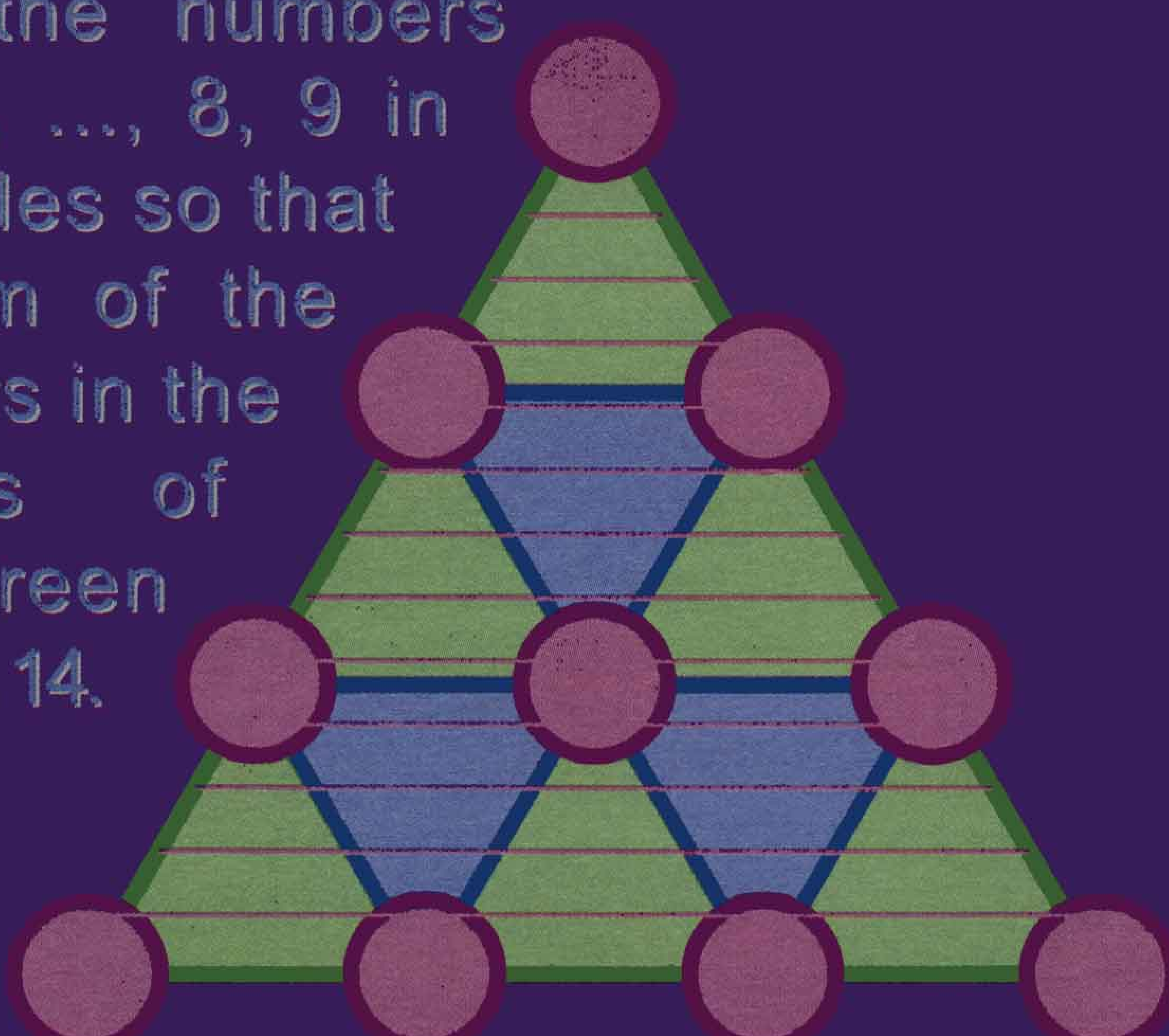
This is an amazing puzzle. We take a drawing of 14 leprechauns and cut it into 3 pieces. When we switch the top two pieces, a 15th leprechaun appears! Switch them back, and he vanishes!



Notice the difference? The top image has 14 leprechauns while the bottom image has 15. Where did the extra little guy come from, and where did he go? Go ahead...count them! Count them again!

This puzzle was taken from **FunkyPages.com**. Visit their website for more mind-boggling puzzles!

Place the numbers 0, 1, 2, ..., 8, 9 in the circles so that the sum of the numbers in the vertices of each green triangle is 14.



four 9's

Use the operations

$+ \quad - \quad \times \quad \div$

and parentheses to combine the four 9's and make each equation below true. For example, we can use four 9's to make 1 like this:

$(9 \div 9) \times (9 \div 9) = 1$

9 9 9 9 = 2

9 9 9 9 = 3

9 9 9 9 = 7

9 9 9 9 = 8

9 9 9 9 = 9

9 9 9 9 = 10

9 9 9 9 = 11

9 9 9 9 = 17

9 9 9 9 = 18

9 9 9 9 = 19

Bulletin Board

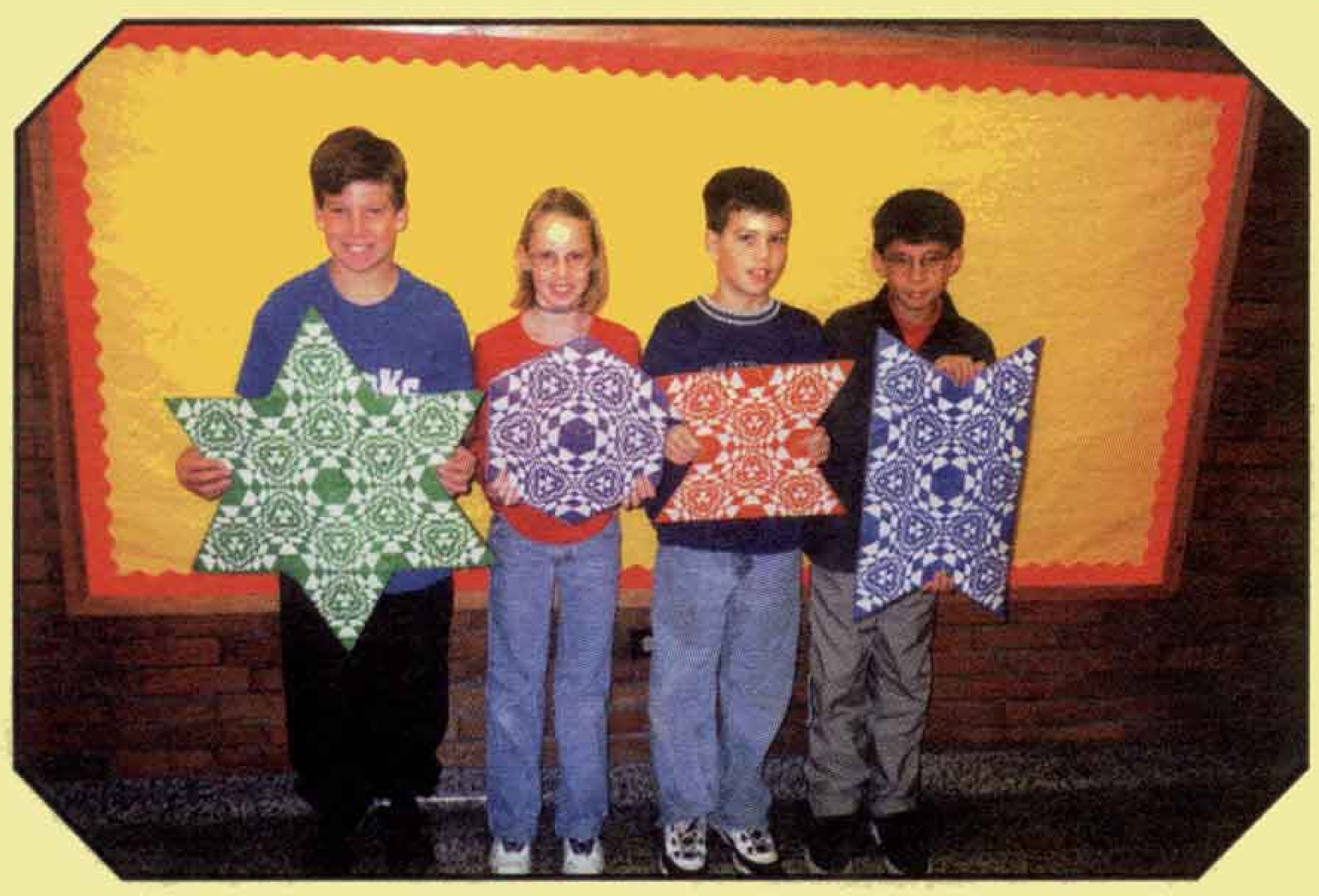
Check it out!

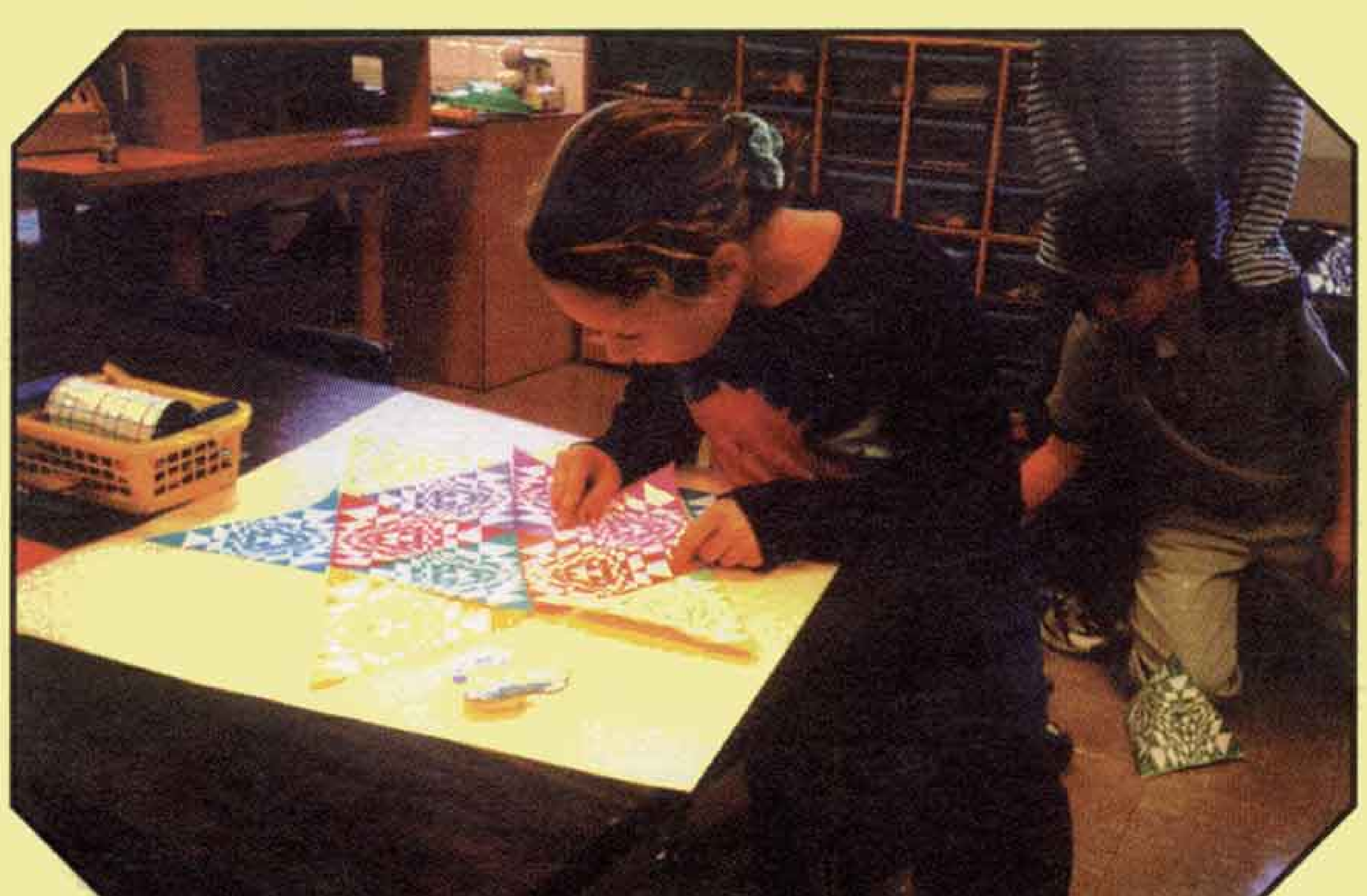
Look at the website www.cc.u-tokyo.ac.jp/README.our_latest_record for news about calculating the digits of π. The world record is more that 200 billion digits!

A Big Math Mistake!!

NASA apparently lost the $125 million "Mars Climate Orbiter" because of a math error when different groups of scientists used different units. This resulted in the satellite going too close to Mars, and so it was lost.

Fibonacci Quilters





The fourth and fifth grade advanced students in St. Charles, Illinois, have been immersed in the study of the Fibonacci sequence. One of their favorite activities was creating Fibonacci x 3 quilts. An equilateral triangle with sides marked with Fibonacci sequence number divisions was the basic quilt shape. By drawing lines to connect the points from each side of the triangle, the students created a variety of shapes which were then colored in alternating patterns. The equilateral triangles were then pieced together to complete their Fibonacci quilts.

Submitted by: Lynn Pittner, Advanced Math instructor in St. Charles, Illinois

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Math Explorer

Welcome to *Math Explorer*!

Science and mathematics seem inseparable, with mathematics serving as the language of science. Just as mathematics can help to explain scientific ideas, science can encourage new mathematical development. It is an exciting partnership and we hope you will enjoy this issue's scientific connection.

Remember to send us any ideas, solutions or comments. We enjoy hearing from you!

Sincerely,

Hiroko K. Warshauer

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