Math Explorer

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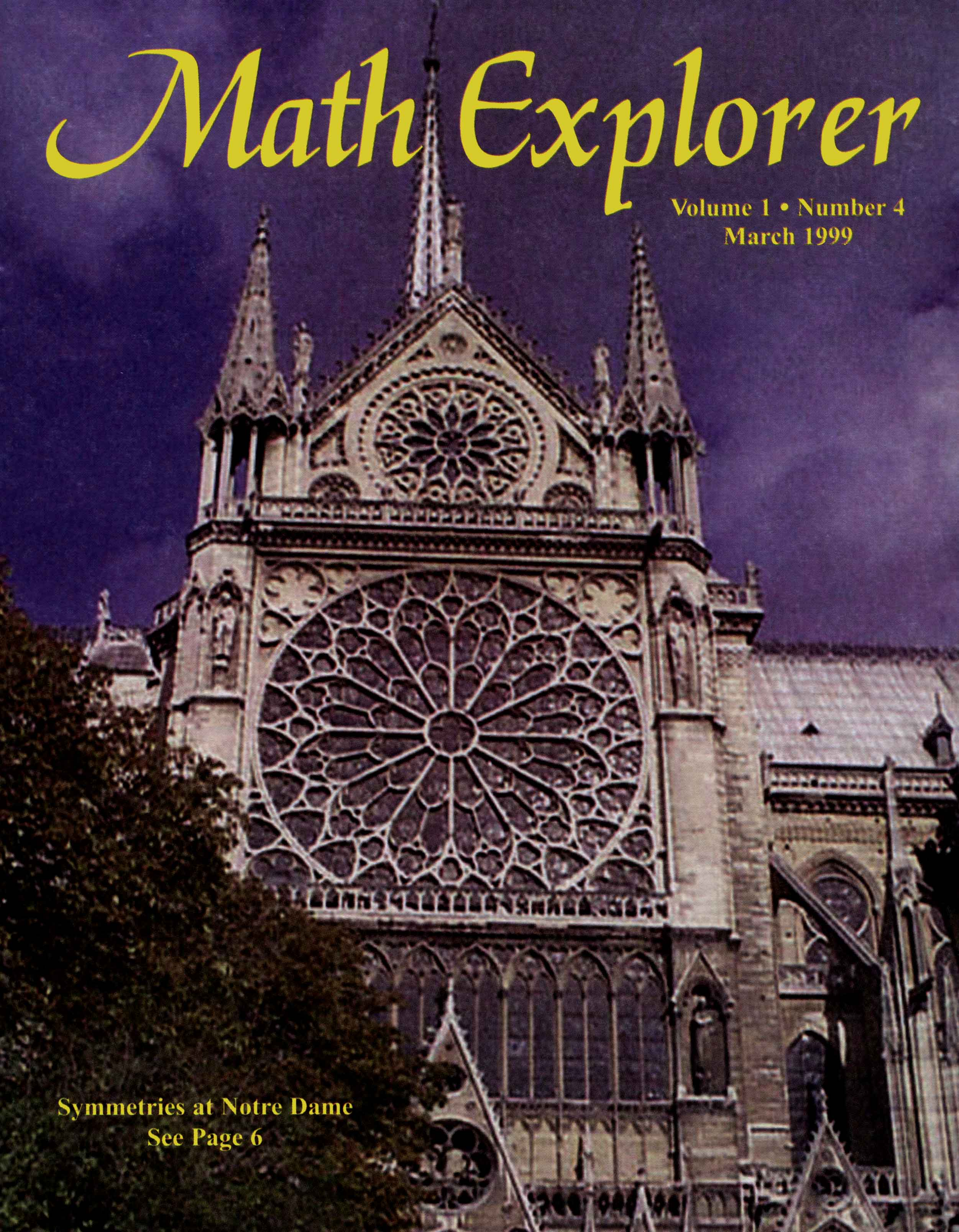

Symmetries at Notre Dame

See Page 6

Math Explorer

Contents

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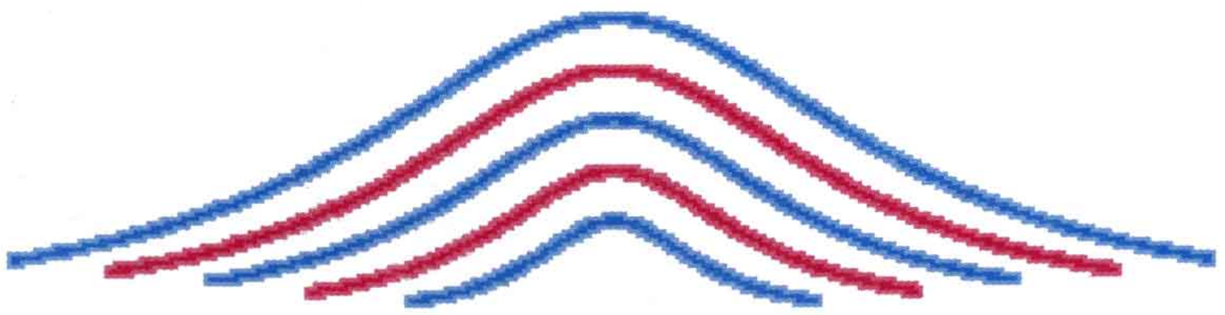
Maria Gaetana Agnesi

by Jean Davis
Jean Davis teaches mathematics at Southwest Texas State University. She enjoys reading and writing historical articles about mathematicians.

One of the most remarkable and extraordinary women scholars was Maria Gaetana Agnesi. The eldest of twenty-one children, she was born in Milan, Italy on May 16, 1718. Her father was a professor of mathematics at the University of Bologna. Her parents discovered her intellectual ability early and planned her education very carefully.

She was truly a child prodigy, speaking French at age five and mastering the classics and several modern languages by age nine. When she was nine, she delivered a discourse in Latin defending higher education for women. Although she was a very shy young lady, she held her own in intellectual discussions with some of the greatest thinkers of her time.

Her greatest work, taking ten years to complete, was *Analytical Institutions*, two volumes on algebra, analytic geometry, and calculus. Originally prepared as a textbook for her younger brothers and sisters, the book was translated into many different languages for use across Europe.



The name Agnesi is associated today with a curve (pictured above) very strangely named "the witch of Agnesi." The term "witch" came about through a mistranslation of the Italian, but has stuck to this day. After the death of her father, Maria Agnesi restricted her study to theology and her activities to caring for the poor. She died at age 80 on January 9, 1799.

[G] *Women of Mathematics*, edited by Grinstein, Louise, and Campbell, Paul J., Greenwood Press, 1987.

[O] Osen, Lynn M., *Women in Mathematics*, MIT Press, Cambridge, MA, 1974.

[P] Perl, Teri, *Math Equals: Biographies of Women Mathematicians and Related Activities,* Addison-Wesley, Reading, MA, 1978.

PROBLEMS OF THE MONTH

Send your solutions to *Math Explorer* ! We will publish the best solutions each month and send a free *Math Explorer* pen to you and your math teacher if we print your solution.

1. How many zip codes (five-digit numbers) can you make if you cannot have a zip code that starts with a 0 or a 9?

2. There is a group of math students, 6 girls and 4 boys. The principal needs to pick one boy and one girl from this group to represent the school at a regional contest. How many ways can he make his choice? How many ways can he pick two arbitrary students?

3. What is the 1999^{th} decimal digit in the decimal form of the number 1/7?

4. How many positive even numbers are there in which the sum of the digits is 8 and the product of the digits is 6?

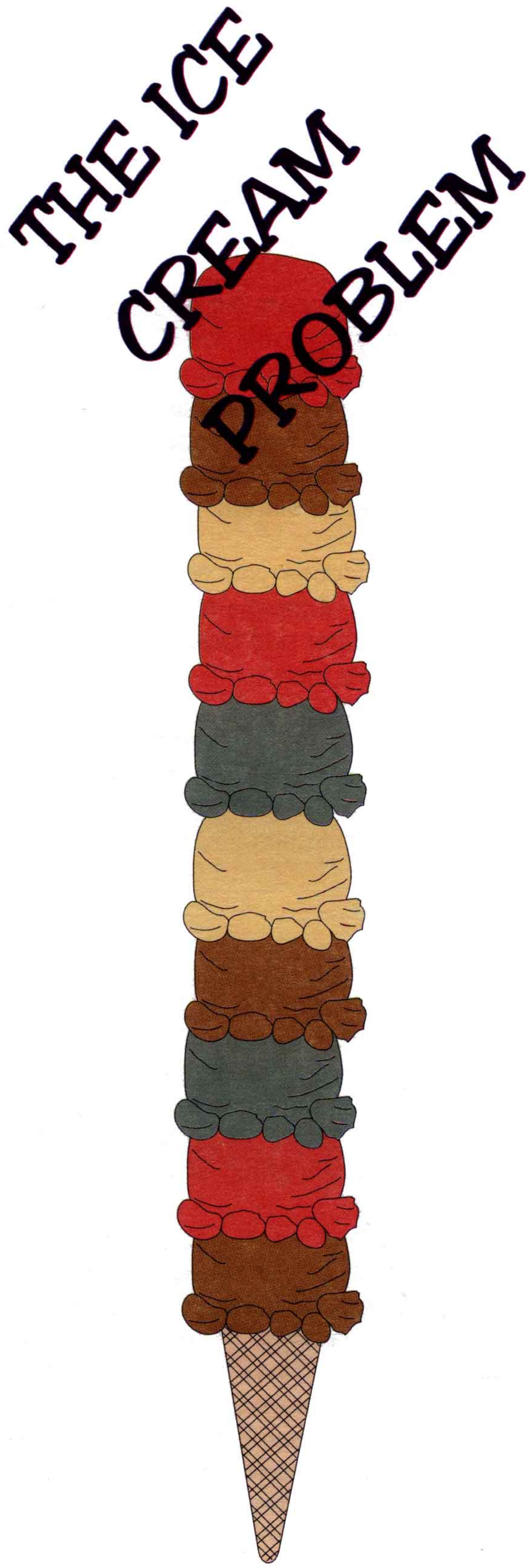
5. How many numbers between 1 and 500 are divisible by 3 or 7? How many are divisible by both 3 and 7?

6. How many four-digit numbers are there in which no two consecutive digits are both even or odd?

7. A baseball manager is making out a line-up card and must decide what the batting order will be. How many ways are there for the manager to arrange the nine players in his line-up?

8. An ice cream store has ten different flavors of ice cream. How many ways can you buy a bowl with two scoops of different flavors? Explain.

9. Ingenuity How many ways are there to buy a bowl with two scoops of ice cream, selected from ten different flavors. How many ways to select three scoops? Be careful--you are allowed to have more than one scoop of the same flavor! How does your answer compare with problem 8 above?



PASCAL'S TRIANGLE

by Janet Chen and Terry McCabe

The Mathematical BrainTrain Society (MBTS) was created by the late Doyle Coats, highly-successful teacher and coach of the A & M Consolidated High School math teams. Knowing that he was dying of cancer, Doyle formed MBTS to help talented math students develop their interest in mathematics. This article is one of a series written by student members of MBTS. Janet is an undergraduate at Stanford University.

There are many fascinating patterns to be found in the number of ways smaller groups of persons or things can be selected from a larger group. Here's a problem to get us started:

Problem: Suppose you want to invite two friends to lunch. The list of people from which you will choose is Alex, Betty, Carol and Don. How many ways can you select your two friends?

Solution: Let's use the letters A, B, C, and D to represent your friends. So AB corresponds to inviting A and B (Alex and Betty) to dinner. In the space below, list all the pairs you could invite.

Did your list include AB, AC, AD, BC, BD, and CD. The number of possible pairs is 6. This is the number of ways to choose 2 persons out of a group of 4 persons. We call this number "4 choose 2" for short, writing it as C(4,2). So C(4,2) = 6 since there are 6 ways to choose 2 persons out of a group of 4.

What if you had wanted to invite only one person to lunch, or three, or four - or none at all? How many ways would you be able to select these lunch parties from a group of four persons? The number of ways to select four persons is C(4,4); the number of ways to select three is C(4,3); the number of ways to select one is C(4,1); and the number of ways to select none is C(4,0). Compute each of these numbers and compare your answers with the chart below:

1	4	6	4	1	1	5	10	10	5	1
C(4,0)	C(4,1)	C(4,2)	C(4,3)	C(4,4)	C(5,0)	C(5,1)	C(5,2)	C(5,3)	C(5,4)	C(5,5)

Note the order of the numbers in this row. We can build a row of numbers in a similar manner when choosing from a group of 3 persons. Write in words what the numbers C(3,0), C(3,1), C(3,2) and C(3,3) mean. Then calculate these values and fill in blank boxes below: Did you notice any patterns in the last row you made? See if they reappear here.

C(3,0) means _____.

C(3,1) means _____.

C(3,2) means _____.

C(3,3) means _____

Compute each of these numbers and fill in the chart below:

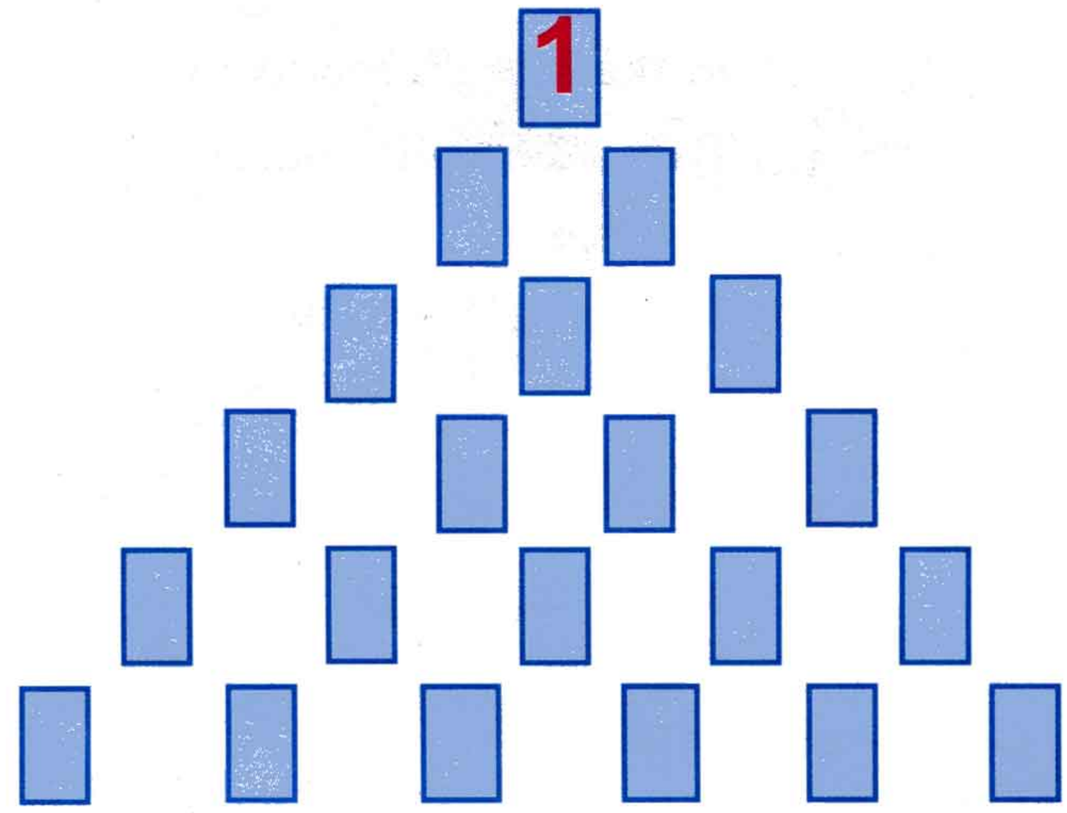
C(3,0)	C(3,1)	C(3,2)	C(3,3)

Now build the rows for choosing from a 1-person group and from a 2-person group. Fill in the numbers below:

C(1,0)	C(1,1)	C(2,0)	C(2,1)	C(2,2)

Eventually we will stack the rows to form an interesting triangular pattern called Pascal's Triangle. But first let's count the number of subgroups of a larger group of 5 persons. Take some time and use the space below to count the number of ways of choosing the indicated number of persons out of 5 persons. Notice any pattern developing in your process. Look for any connections with the results obtained in choosing from a group of 4.

Stacking these rows from shortest to longest gives us the beginning of Pascal's Triangle (which actually has an infinite number of rows). Fill in the first five rows of triangle below with the numbers you have calculated.



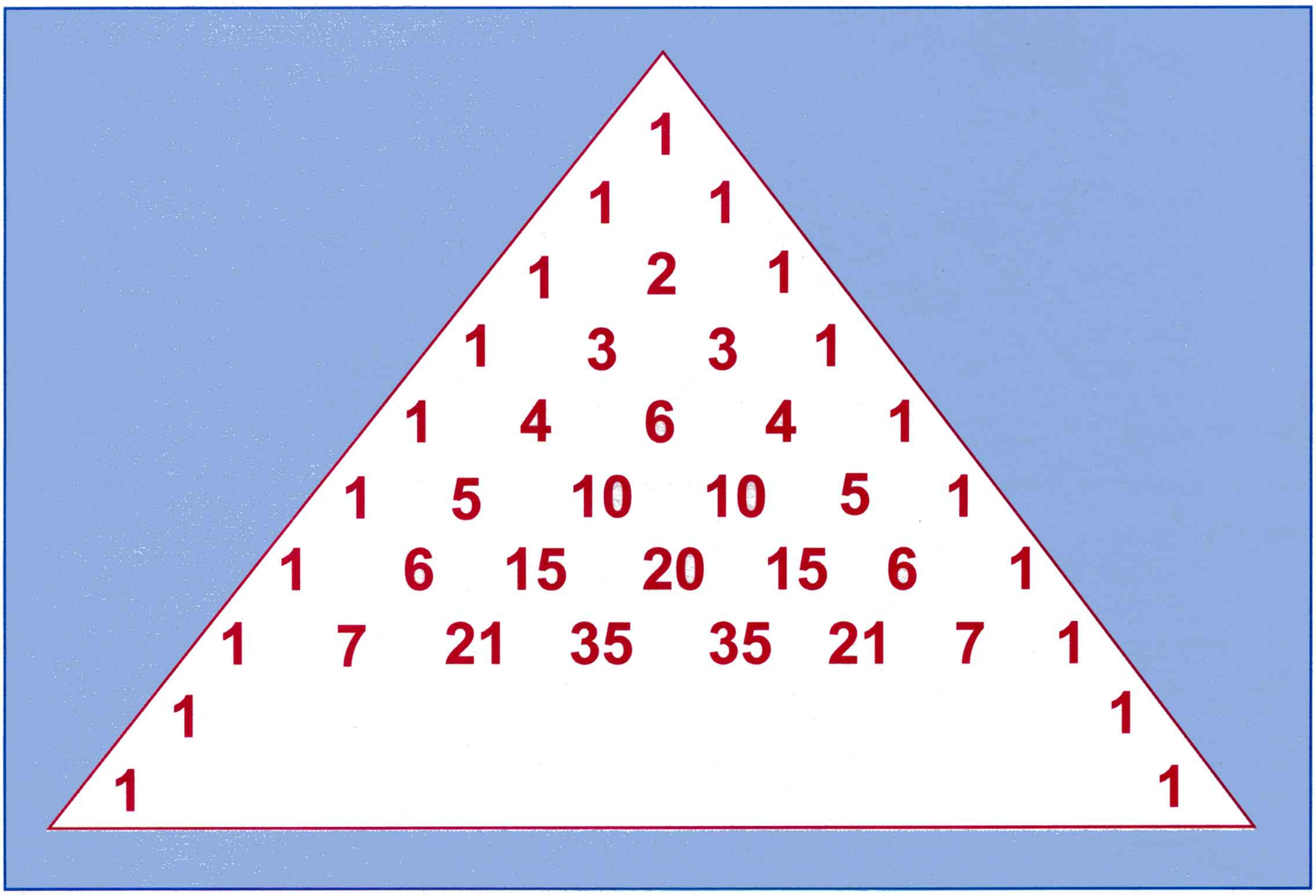
Pascal's Triangle is full of patterns! Can you see any that might help you guess the numbers on the sixth row? To check your guesses, calculate some of these numbers by the counting method you used before. See if you can explain where these patterns come from.

Here are some more questions about patterns you may discover:

1. Look at the diagonals in the triangle. Starting at the top of the triangle, go down a row at a time, adding the number at the end of each row. Can you find the sum at each level on the next?

2. What do you think happens if you sum the numbers along other diagonals?

3. If you put your finger on any number in the middle of the triangle, can you have predict its value just by looking at the levels above it?



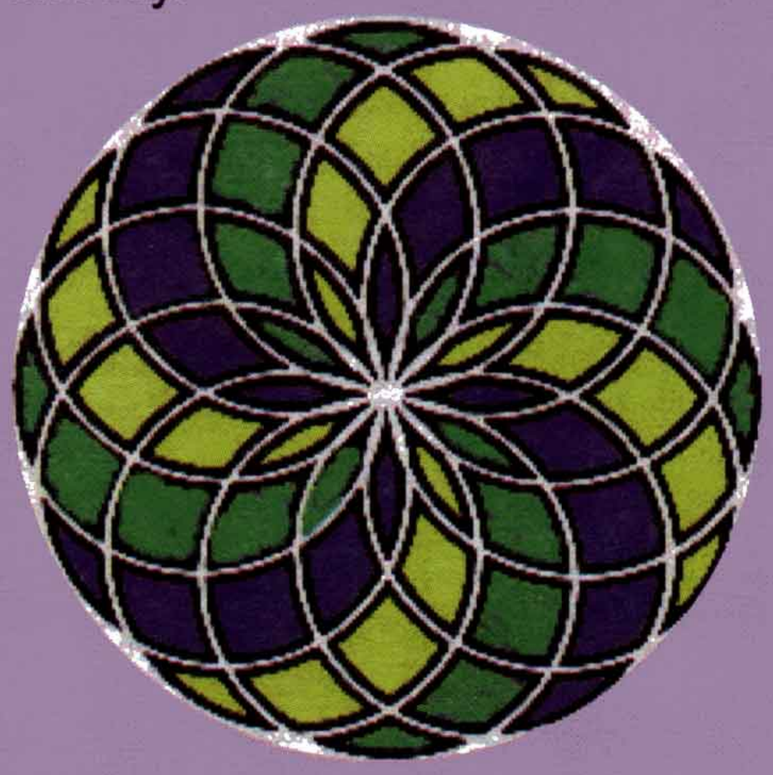
Puzzle Page

Math Explorers,

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

SYMMETRIES

There are exactly four different angles not greater than 360 degrees by which the diagram below can be rotated to cover itself perfectly.

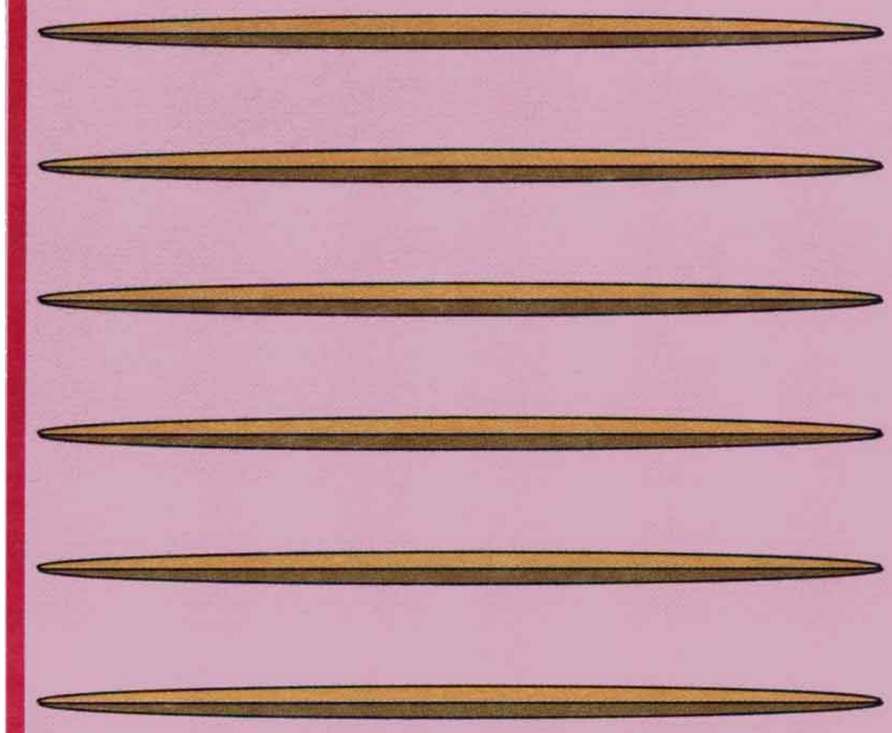


Therefore, the diagram is said to have a fourfold symmetry. Could you color the diagram so that it has a threefold symmetry? a sixfold symmetry?

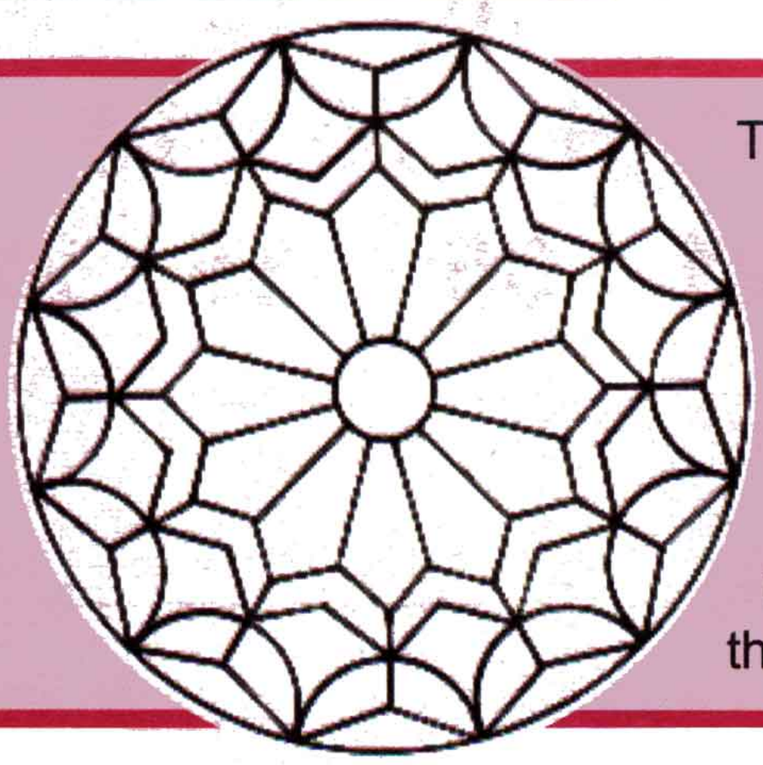
FOUR TRIANGLES

Arrange 6 toothpicks to make four equal triangles.

Hint: If you cannot do this on a flat surface, what else might you try?



THE CATHEDRAL OF NOTRE DAME PROBLEM



The picture on the cover is of the cathedral of Notre Dame in Paris, reprinted with permission of Anthony Atkielski. See his web-site at "http://www.atkielski.com". On the cathedral is the shape to the left. Can you color this so that it has sixfold symmetry? fourfold? threefold? twofold?

BULLETIN BOARD

Summer Math Camps in Texas!!!

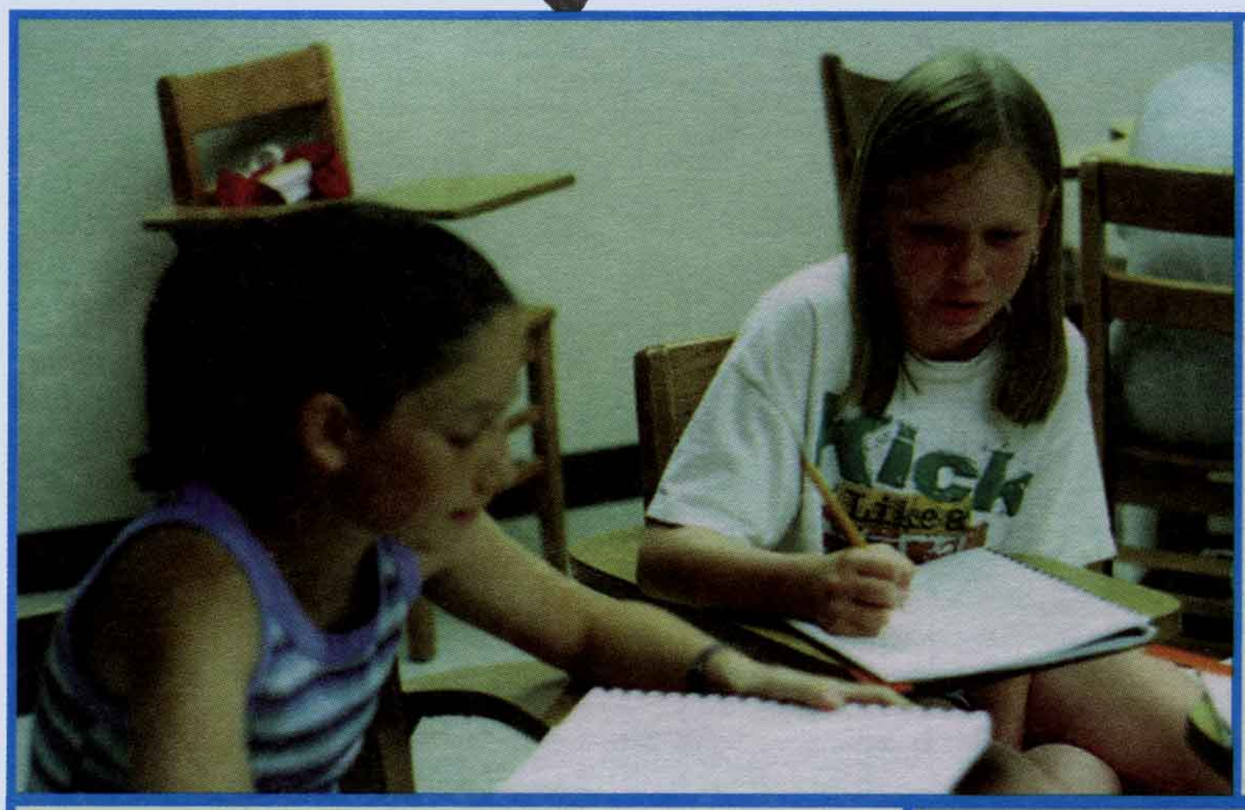
Junior Summer Math Camps are springing up all over Texas. Camps are planned this summer in San Marcos, Port Lavaca, Houston, Lockhart, McAllen, Donna, Rio Grande City, La Joya, Progreso, Mission, and Hidalgo. Check for a camp in your area.

Rice Math Contest

is scheduled for Feb. 27. For details, see the website http://www.ruf.rice.edu/~eulers/RMT.shtml

Math Riddle:

How can half of twelve ever be seven? See back cover for the answer.



Last summer, San Marcos students enjoyed the third annual Southwest Texas State University (SWT) Junior Summer Math Camp. Pictured on the left are two students working together on math problems. For information about the 1999 SWT Junior Summer Math Camp, contact Dr. Max Warshauer at 512-245-3439.

Pictured on the right is a student and his teacher from the 1998 SWT Junior Summer Math Camp. New Junior Summer Math Camps are springing up all over Texas. The Eisenhower program sponsored training programs for the teachers.

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Schools and individuals are encouraged to subscribe now for next year to insure that you don't miss any issues! Our May issue will be the last in Volume I. We will resume again next September with Volume II. All subscribers from last year will continue receiving Math Explorer until they have a full collection of 8 issues, which in most cases will end in October. Thanks again to everyone for your wonderful support. We hope to hear from you all soon!

Answer to Riddle: Use Roman numeral XII and slice horizontally.