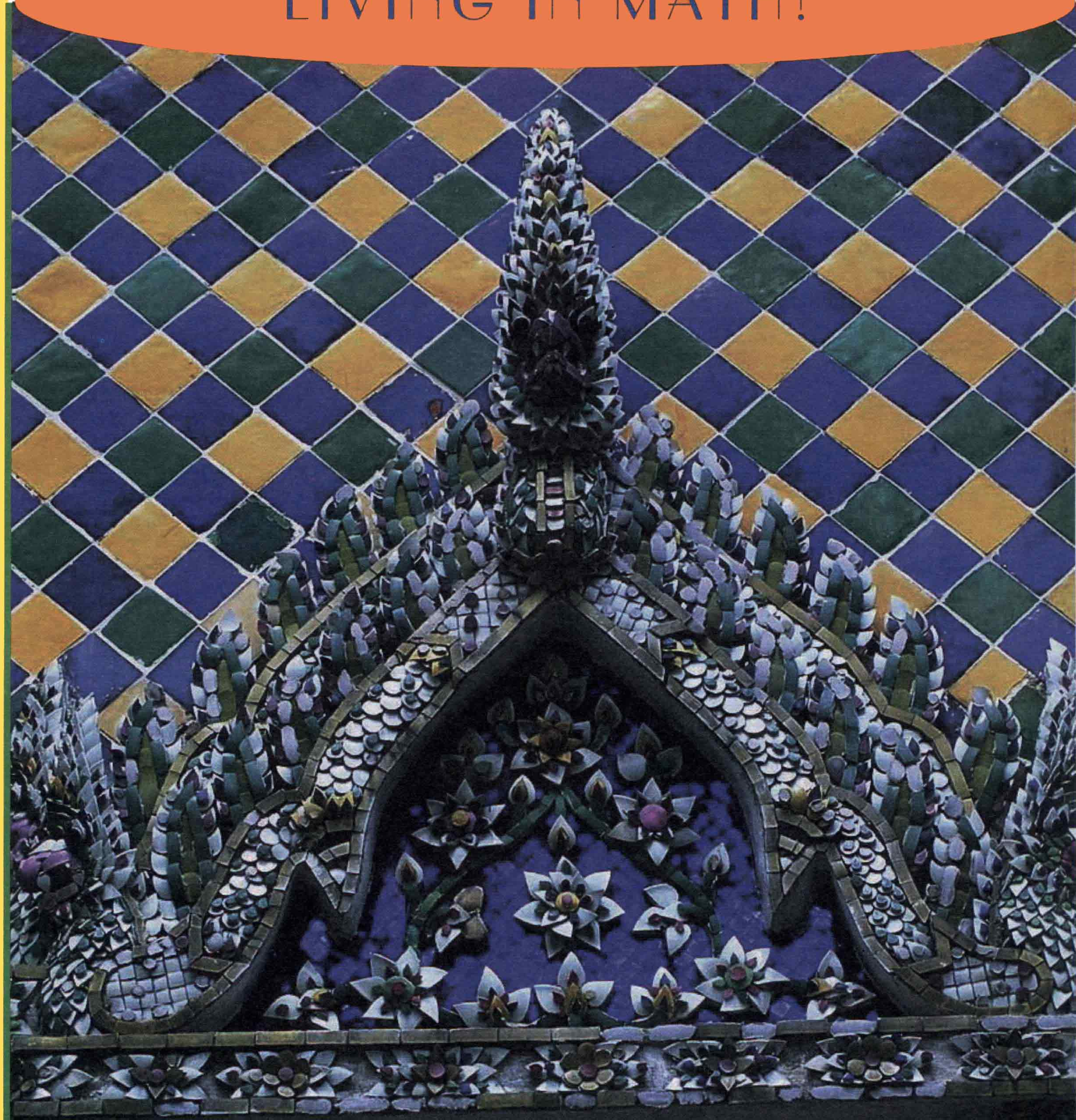
# Math Reader

## LIVING IN MATH!



Vol. 2.2 November 1999

# Math Reader

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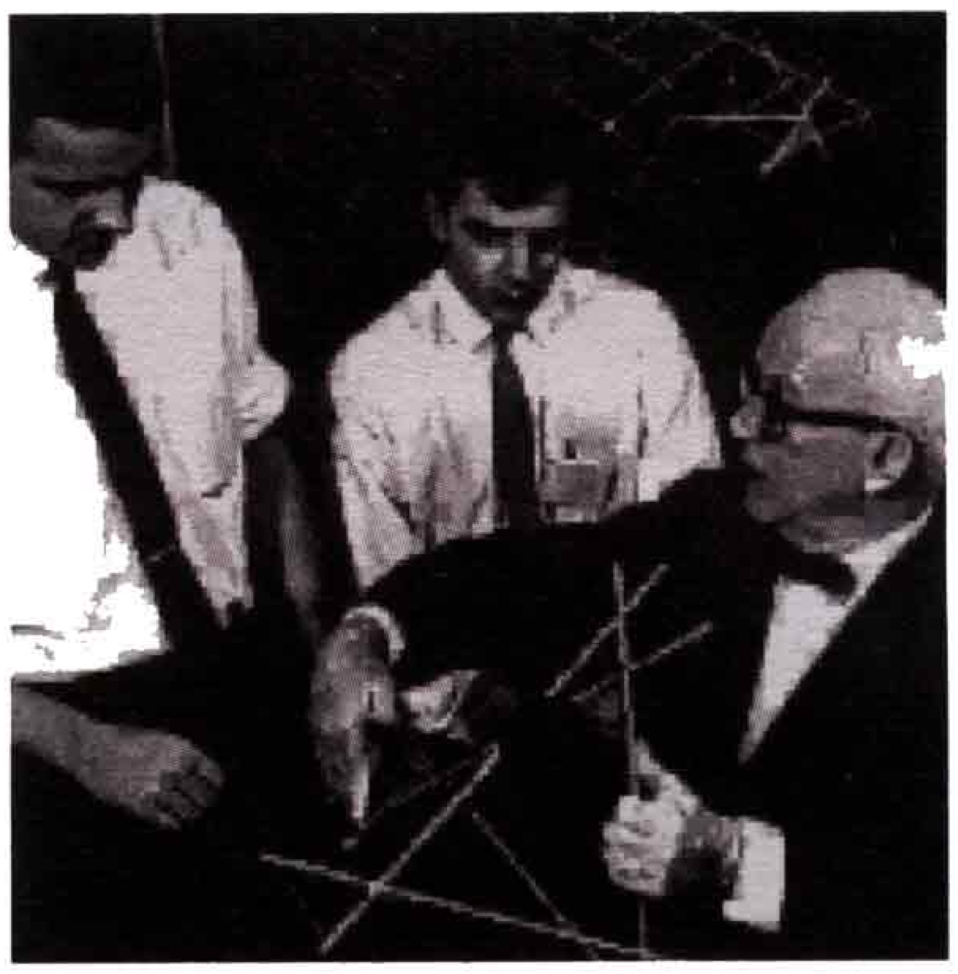
# *Buckminster Fuller*



Buckminster Fuller, affectionately called Bucky, is most famous for popularizing the geodesic dome. The geodesic dome is a ball like structure that uses basic geometric shapes to enclose the largest space with the least surface area. For example, by using a chain of triangles you can form a ball. This is one way that a geodesic dome is constructed. You might have noticed the geodesic dome of Disneyland's EPCOT Center.

The geodesic dome was invented by Walter Bauersfeld of Germany in 1922 and was used as a planetarium on the roof of the Zeiss Optical Works. It was Fuller, however, that used mathematics to improve the design and engineering of these spherical shapes . Fuller's concern for and interest in his environment, housing, and shelter led him to focus on the study of spherical geometry in order to help solve some of the problems that confronted our world. The dome was an original concept for housing; it is very different from the rectangular-shaped buildings we know. In terms of materials, costs, and weight, Fuller's geodesic dome is a superior design, and he received several patents for them.

Fuller was born in Milton, Massachusetts in 1895. He attended Harvard College but finished his degree at the Naval Academy. He is known as an inventor, mathematician, architect, engineer, poet and thinker. He received numerous honorary degrees from institutions for his work in various fields. He coined the term "Spaceship Earth." By this he meant that the people on this planet are like the crew of a ship who must work together in cooperation and always with consideration for the environment. In the 1980s, a new molecular form of pure carbon was discovered. It was named the Buckyball, in honor of the innovative thinker Buckminster Fuller.

Sources: www.worldtrans.orgwhole/bucky, www.insite.com.br/rodrigo/bucky/geodesic_domes.txt

by Hiroko K. Warshauer, who teaches mathematics at Southwest Texas State University. She enjoys music and the arts, as well as working with students on math puzzles, problems, and activities.

# PROBLEMS OF THE MONTH

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 Reader** pens!

1. Cut four pieces of string and tie the ends so that each loop has the same length. Make an equilateral triangle, a square, a pentagon, and a hexagon. Which of these figures has the most area? Explain.

2. Paint the vertices (corners) of a cube so that each face has at least one blue vertex. What is the smallest number of blue vertices needed?

3. You are given 8 coins which look identical. Seven coins have the same weight, but the eighth, a counterfeit, is a bit lighter than the rest. What is the smallest number of weighings on a balance scale guaranteed to determine which coin is the fake?

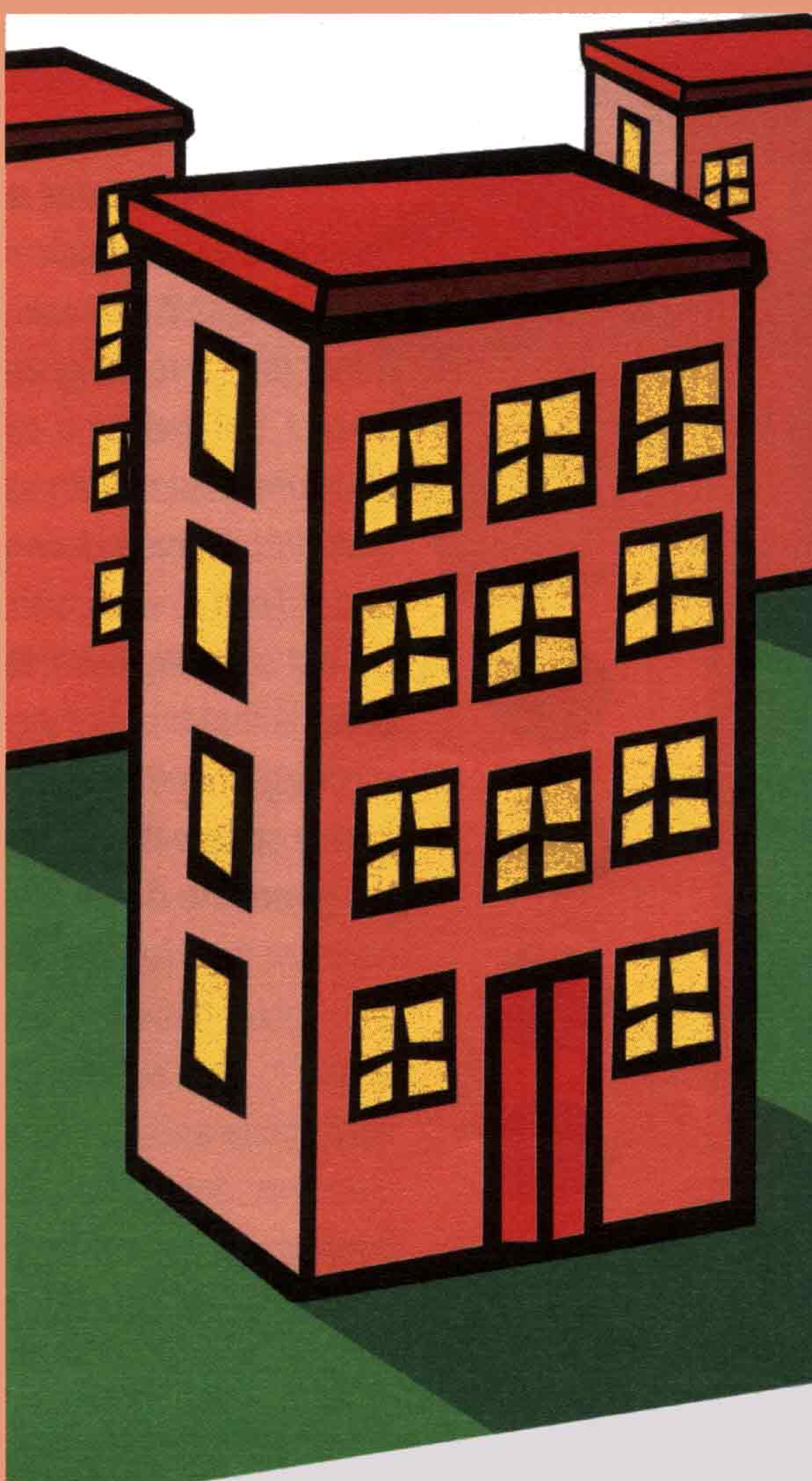
4. A candy bar costs 65 cents in the candy machine. You have 20 quarters, 20 nickels, and 20 dimes in your pocket. In how many ways can you pay for the candy bar?

5. Jane is giving a dinner party for 18 people. She wants to use her card tables to seat the guests by setting them up end to end in one long row. A card table on its own seats 4 persons, one on each side. How many tables does she need?

6. A soccer league has 196 people signed up. There are the same number of kids on each team as there are teams in the league. How many teams are in the league?

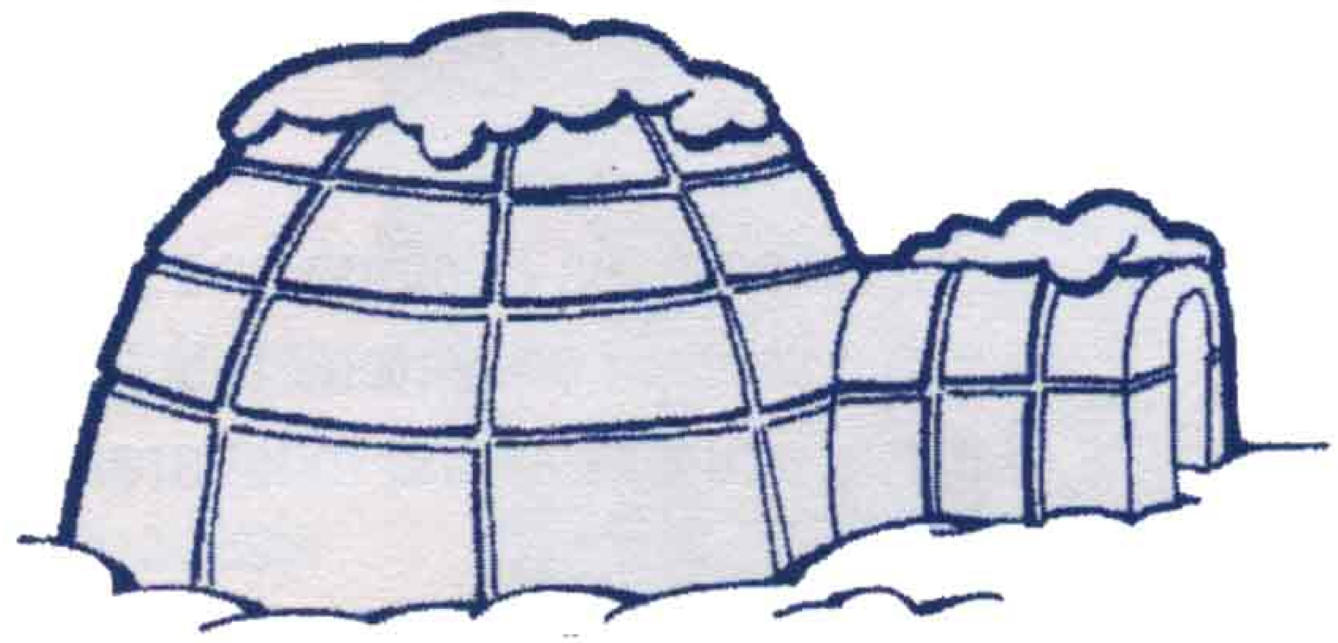
7. Mr. Smith is 6 feet tall. Mrs. Smith is 5 feet 8 inches tall. They have twins who are the same height. The average height of the 4 family members is 4 feet. How tall are the twins?

8. INGENUITY. Maria has a house the shape of a cube. The length of one side of her house is twice as long as the side of Robert's cube-shaped house. How many times bigger is the space (inside volume) in Maria's house?

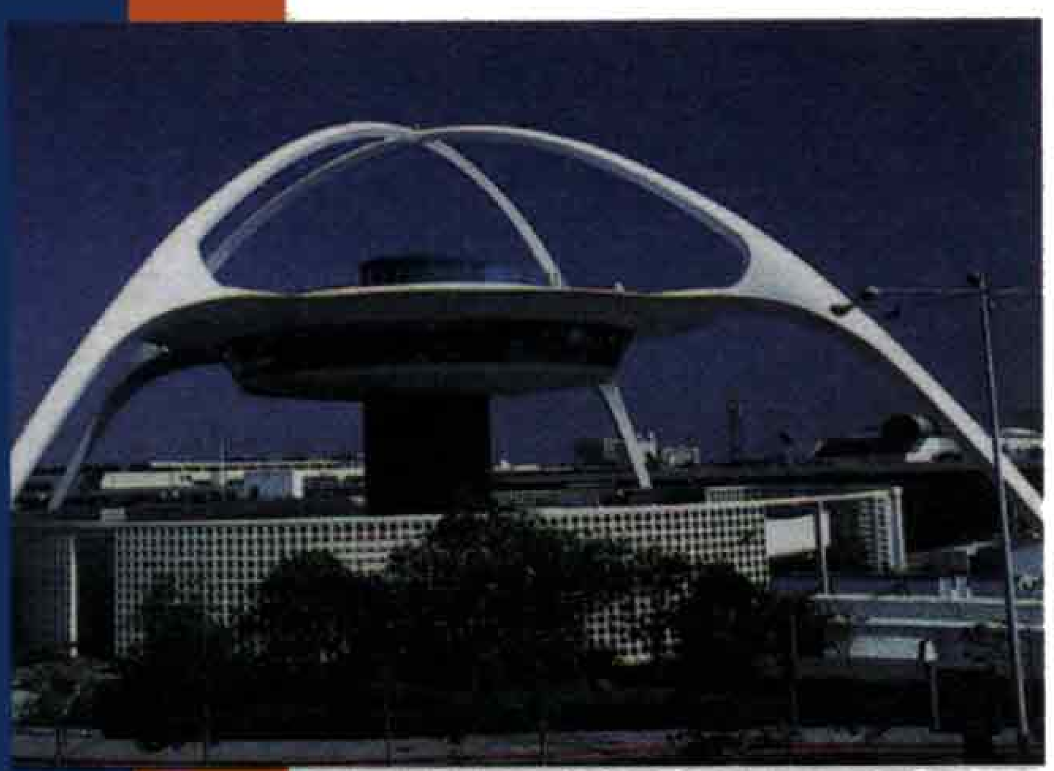


# Better Buildings?

by Terry McCabe

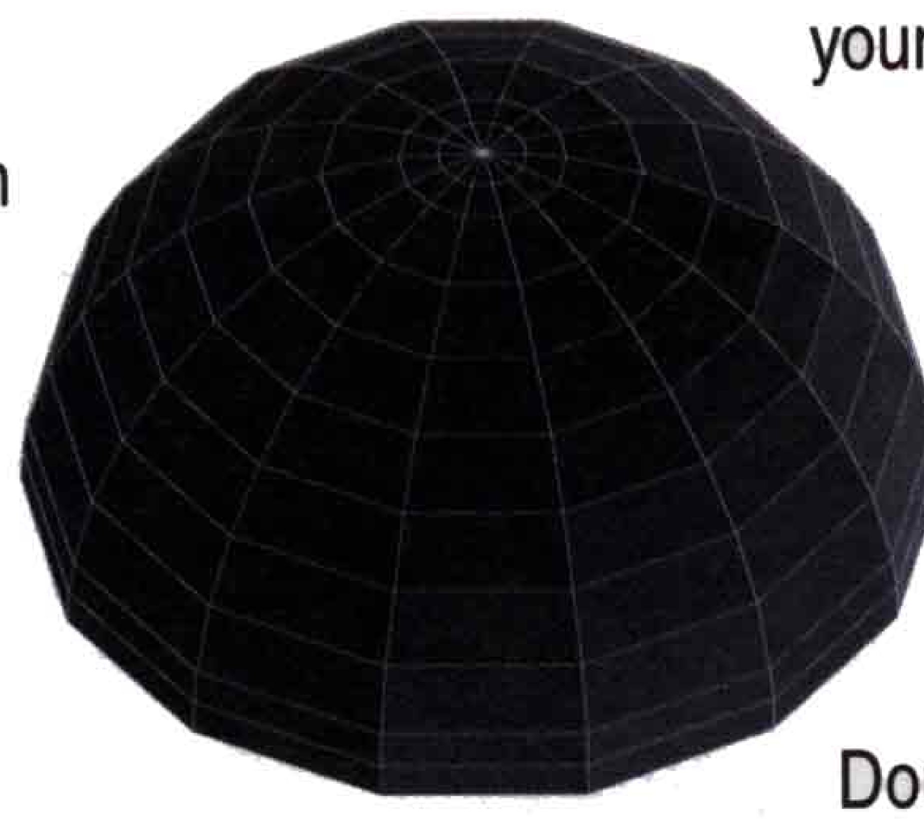


If you want to design a house, you might begin by making a list of all the things you think are important. What would your list be like? Did you think about windows, or stairs? What about places to rest? Did you include the amount of the materials you use to build a home? This may sound strange, but this was one of the most important parts of the designs of a very special architect named Buckminster Fuller.



Buckminster Fuller believed that a building should have as much space as possible inside, while using as little material as possible on the outside. Can you think of the shape that would do this best? If you said half of a sphere, rather than a rectangular block, you are correct. But making a spherical-shaped structure would mean using curved materials. Curved material is uncommon and difficult to work with. However, this did not stop Mr. Fuller. He thought of designs that brought pieces of flat, regularly-shaped materials together to form a sphere-like shape. He called this the **geodesic dome**. These shapes are stronger than regular arches, and can be made with lighter materials. In addition, they are easier to heat and keep cool. They are also very stable and can resist winds. Geodesic domes can use patterns of self-bracing polygons (triangles, pentagons, hexagons, etc.) in patterns that give the most strength and stability. The larger the dome, the lighter and cheaper the material per cubic foot of inside space. Rectangular buildings require heavier and stronger materials as they get bigger.

Now let's try making some geodesic domes. You can use toothpicks and little clay balls or foam balls to stick them together. Or you can cut out many polygons using construction paper and tape them together into a half sphere. Use triangular patterns to experiment with building different shapes of domes. Some of them can be made of rows of triangles, while others can be made of triangles that form pentagons or hexagons. Try making your own patterns.

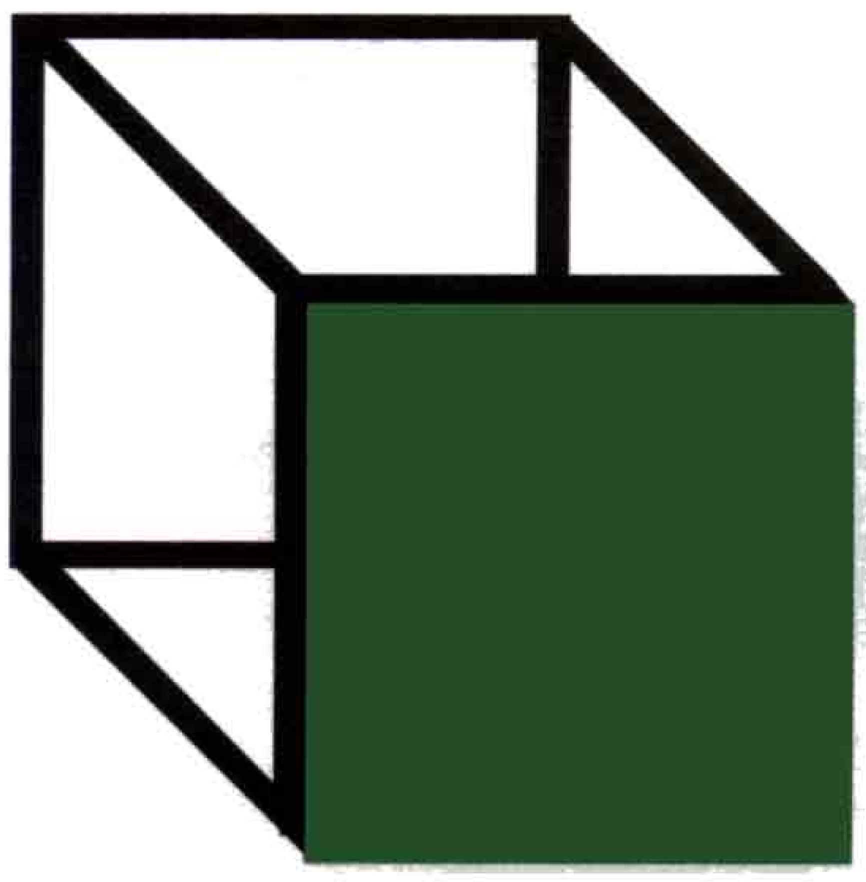


Geodesic domes can be built so cheaply and easily that some domes have been built in just a day or two. Domes have even been built in difficult sites, like the tops of mountains and in the Arctic. Some domes can also withstand earthquakes and hurricane winds. So why don't we see more domes? To read more about Mr. Fuller and the geodesic dome, visit: www.wnet.org/archive/bucky/dome.

# Platonic Solids

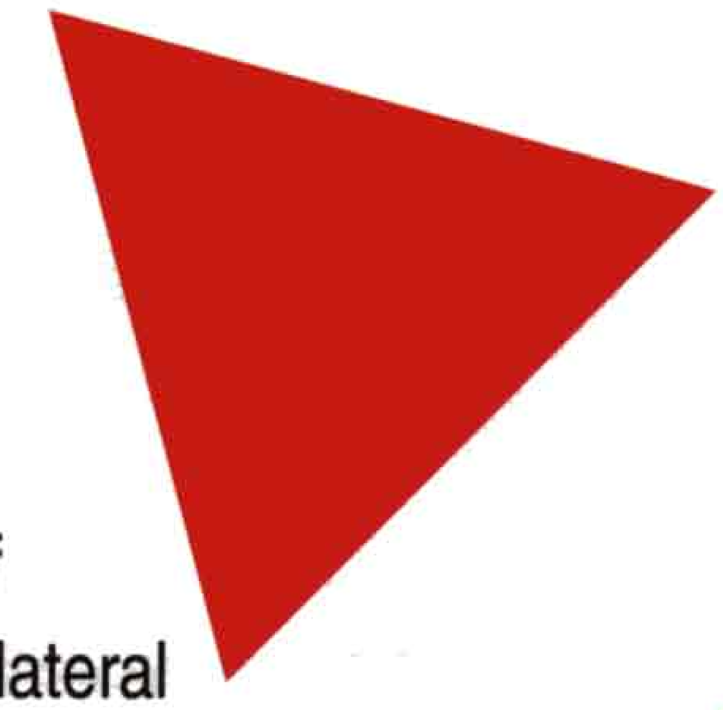
by Eugene Curtin and Terry McCabe

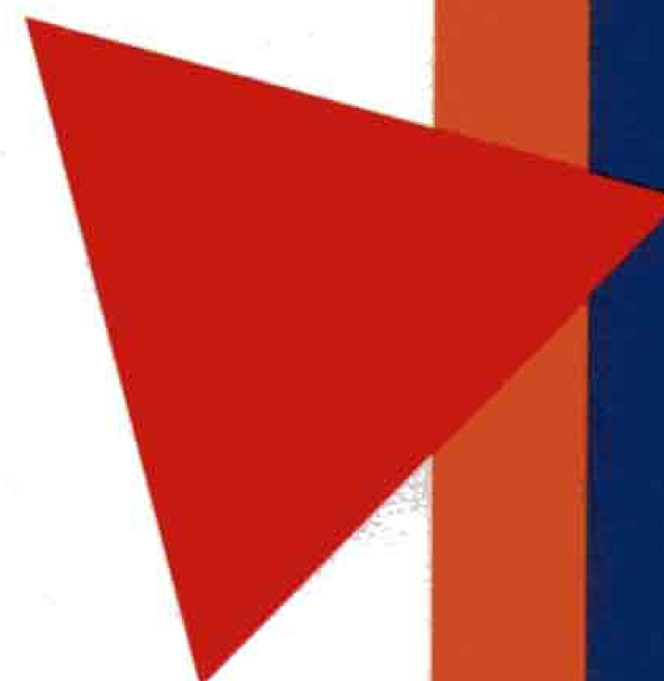
Have you ever looked at a cube and thought how special a shape it has? What makes a cube so unique among solid objects? Each of its sides is the same shape, a square. The square is an example of a regular polygon. A **regular polygon** is a polygon in which all the sides are the same length and all the angles are the same measure. Other regular polygons are the equilateral triangle, the regular pentagon (5 sides), the regular hexagon (6 sides), and so on. Are there other solids besides the cube that have only regular polygons for sides? This sounds like a fun problem to explore with paper and scissors. Get some stiff paper (like poster board) that will cut fairly easily but still hold its shape.



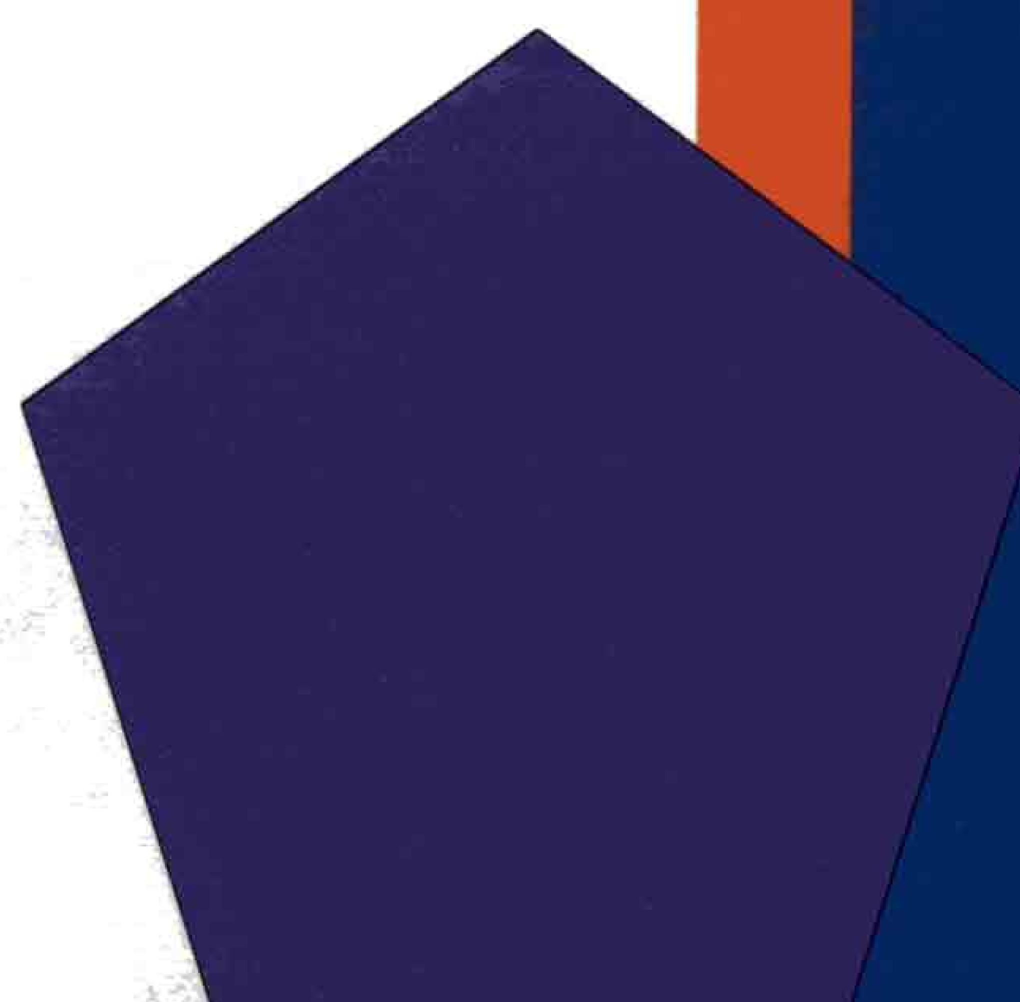
First, let's explore solids with square sides. Cut out at least ten squares of exactly the same size. Ready to try your hand at building a solid besides a cube from the squares? Ready, go! (You might try using tape to connect the sides together.)

You probably found it rather difficult to build any solid besides a cube from your squares. In fact, you can't! Instead of squares, let's try using equilateral triangles. Start by cutting out at least 40 equilateral triangles. You may use the triangle on the right as a pattern. Explore the possible shapes! We don't want to spoil your fun, but here's a hint. There is more than one solid that can be made from these triangles, and 40 will be enough for all of them.



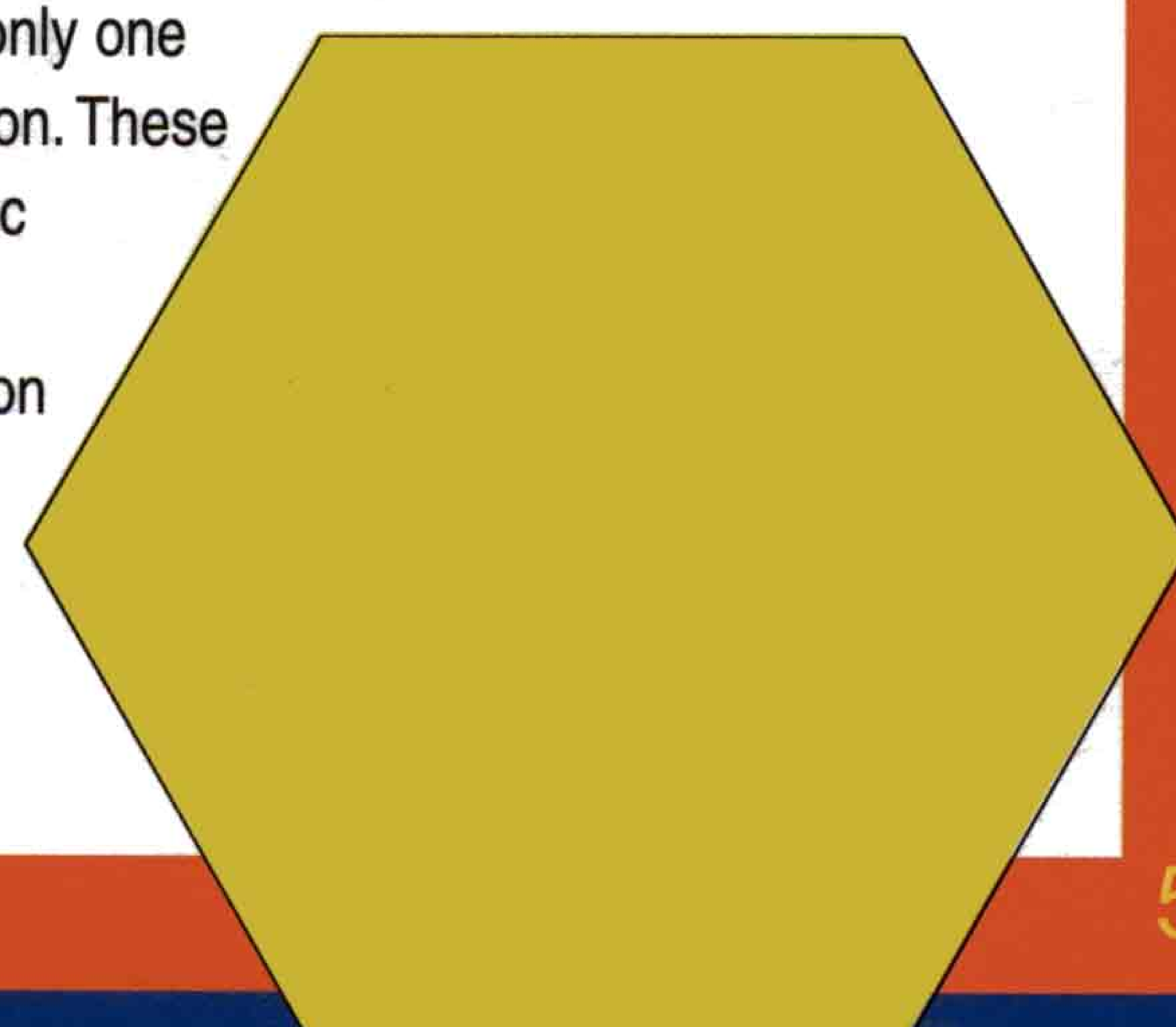


The next regular polygon with which you can experiment is the regular pentagon. Use the example to the right as a template for cutting out at least 15 pentagons. There is one solid that can be built using regular pentagons, so work carefully to discover what it is.



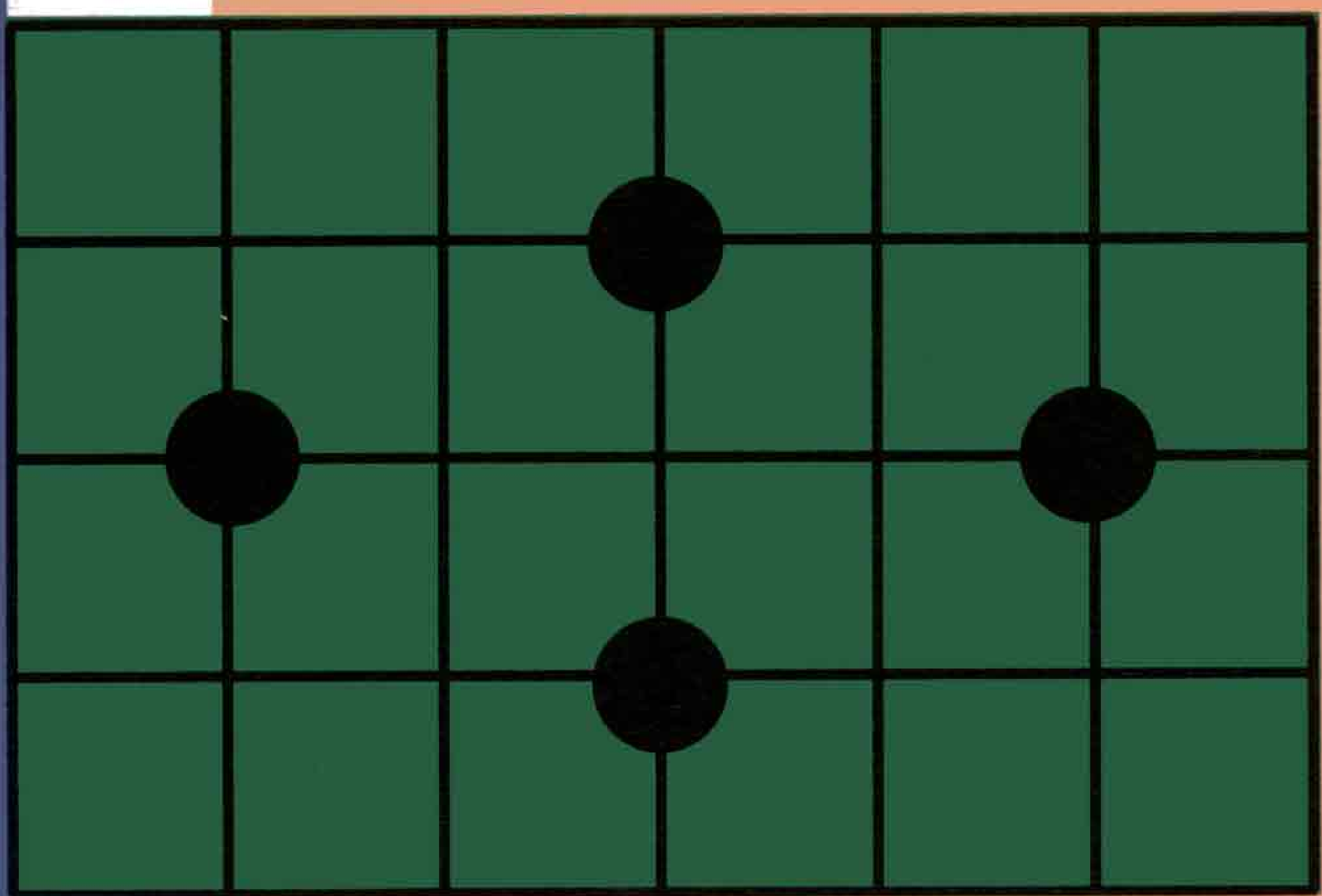
What about other regular polygons, such as a regular hexagon? Cut out some hexagons and try making a solid.

After you experiment with hexagons, you may come to the conclusion that there is no solid that can be made with them. That is correct. In fact, there are only 5 solids that can be made using only one type of regular polygon. These are called the platonic solids. Look for their names and pictures on our website next month!



# Puzzle Page

**Math Readers:** 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 Reader** pens.



**The diagram indicates a land with four wells on it. Divide this land into four parts that have the same size and same shape with one well on each part.**

## Word Search

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

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SYMMETRY | S | S | X | L | E | A | W | Z | D | T | E | S | M | B |
| PATTERN | S | T | E | I | G | I | T | I | V | E | E | P | F | T |
| SPIRAL | P | H | T | O | S | R | I | E | N | Q | E | A | I | R |
| SEQUENCE | I | G | R | M | M | U | R | A | U | R | O | E | B | N |
| FIBONACCI | R | E | E | N | I | P | A | E | S | S | I | R | O | O |
| RATIO | A | C | F | R | I | A | N | P | L | E | E | A | N | I |
| GEOMETRIC | L | N | L | F | T | C | P | L | E | R | A | U | A | T |
| REFLECTION | T | E | E | O | E | C | A | V | H | T | G | N | C | A |
| ROTATION | K | U | C | T | Y | R | T | E | M | M | Y | S | C | T |
| | P | Q | T | I | I | E | T | E | R | E | L | H | I | O |
| | R | E | I | P | A | B | E | G | N | O | I | T | A | R |
| | T | S | O | G | N | G | R | A | O | T | M | E | W | X |
| | D | I | N | G | B | M | N | N | C | H | A | T | R | M |
| | Z | C | I | R | T | E | M | O | E | G | S | U | F | I |

**Jennifer goes to a water fountain with two containers, one holding 7 cups and the other 4 cups. She wants twice as much water in one container as the other. How can she do it?**

# Bulletin Board

## FIPSE Sponsors Summer Math Camps

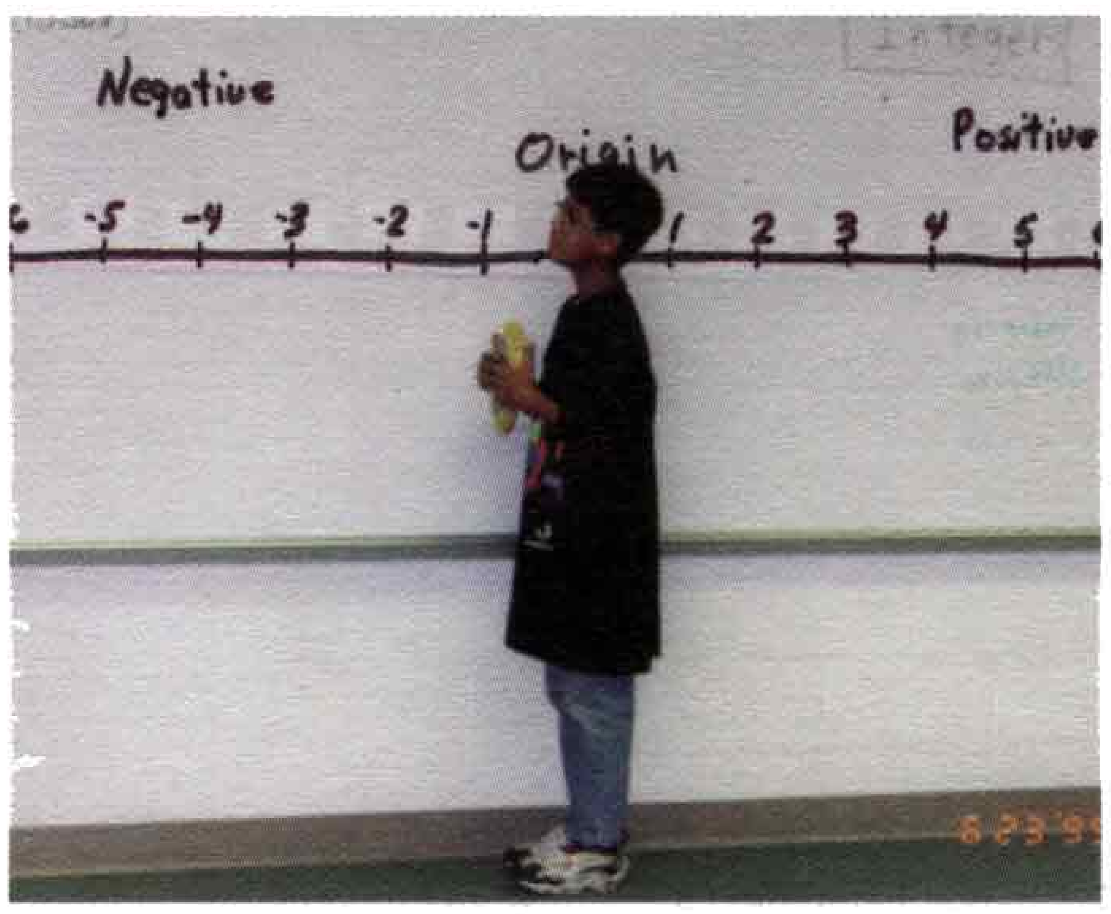
Funds for Improvement of Postsecondary Education (FIPSE), is sponsoring 3-year training program for teachers to offer the SWT Junior Summer Math Camp in the Rio Grande Valley. The program is being coordinated by Elaine Hernandez, Director of Continuing Education at South Texas Community College. Call her at (956) 971-3712 for more information.

## Thanks Southwestern Bell!

Southwestern Bell Communications (SBC) Foundation sponsored the Rio Grande Valley Summer Math Program, which was coordinated by Adelina Alaniz from Mission. Participating school districts included McAllen, Donna, Progreso, and Mission. Welcome to our new partners! And a special thanks to SBC which made the program possible!

## Camp Snapshots!

Sixto Vasquez from the 1999 McAllen Junior Summer Math Camp enjoys driving on the integer highway. Other students enjoy the McAllen summer math camp activities.

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Welcome to **Math Reader**!

We are excited to bring you this year's second issue of **Math Reader**, which focuses on the connection between math and architecture. This issue comes with many new and challenging problems. Write to us with any solutions you find, as well as any puzzles or math activities you would like to share. We want to post your submissions on our website: www.mathexplorer.com. When you write, send us your address, school name, and math teacher's name. If you would like, include your picture as well.

We look forward to learning and growing with our readers.

Sincerely,

*Hiroko K. Warshauer*

Hiroko K. Warshauer

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