

Thinking Mathematically

A Newsletter for New Hampshire Adult Educators • Issue 8 • April/May 2006

From the Editor...

Greetings from a very hot Ouagadougou. We're in the midst of hot season now, waiting for the cooling rains that will start in June.

This issue is about geometry, one of my favorite areas of mathematics. I've often found that students who struggle with arithmetic and algebra have more success with geometry, especially if it is taught in a hands-on, visual way. Some students are visual learners, and for these students, geometry can seem "easy".

Are you a visual learner? Think about the following problem. If you are parking your car on a hill beside a curb, facing up the hill, can you visualize which way you should turn your front wheels so that the car won't roll down the hill if the brakes fail? How about if the car is facing downhill?

Give your students opportunities to play with shapes, to visualize what they can't see in front of them, and to discover the properties of figures and solids on their own. Although thinking geometrically and seeing shapes in your mind's eye come easily to some students, these skills can be taught to all.

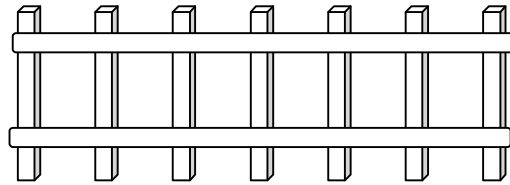
As the school year is winding down, I'm realizing that this will be the last issue of *Thinking Mathematically*. I hope you have found some useful bits in these pages over the past 8 months, and I hope you have a relaxing vacation.

~Ruth
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Focus Issue: Geometry

Problem of the Month

The centers of fence posts are 30 inches apart. They enclose a triangular region 20 feet by 20 feet by 10 feet. How many posts will be needed? (source: Mathematical Challenges for the Middle Grades, NCTM.)



Geometry of the Globe

If you were suddenly transported to the following locations on the globe, where would you be? (Latitude is always mentioned first in locating places; longitude second.) [source: *Creative Teaching Associates, 1975*]

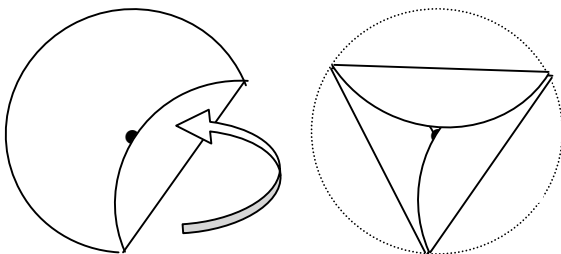
- A. 51° N. 0° W.
- B. 41° N. 75° W.
- C. 23° S. 43° W.
- D. 34° N. 140° E.
- E. 37° S. 145° E.
- F. 37° N. 123° W.
- G. 56° N. 37° E.
- H. 33° S. 18° E.
- I. 34° S. 58° W.
- J. 64° N. 22° W.



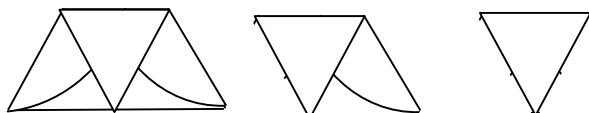
Folding a Paper Circle

The following paper folding activity is one of my favorites, and can be adapted for all levels.

1. Start with a circle cut from newsprint that is about 12 to 15 inches in diameter. Draw the circles with a compass, and mark the center of the circle (or have students locate the center by folding two diameters).
2. Take the edge of the circle and fold it back onto the center three times in such a way as to form an equilateral triangle.

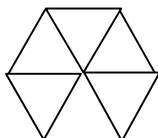


3. Fold one vertex to the midpoint of the opposite side to form an isosceles trapezoid (a). Fold another vertex to this same midpoint to form a rhombus (b), and fold all three to form a small equilateral triangle (c).



a. b. c.

4. Open the model up so that the four equilateral triangles form a regular tetrahedron (like a pyramid).
5. Fold each vertex of the initial triangle into the center, and a regular hexagon is formed.

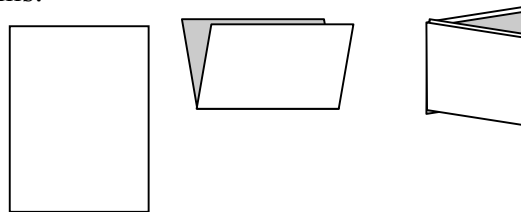


6. Rest the folded paper loosely in your hand. You can tuck the three upper flaps together to form a model of a truncated tetrahedron (a pyramid with the top chopped off).

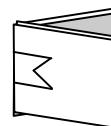
(source: Teaching Mathematics, Sobel and Maletsky, 1988.)

Geometric Guess and Check

This activity helps students visualize what they cannot see. Fold a piece of paper in half, and then in half again, like this:



Cut out a shape on the fold. For example:



Before unfolding it, have students try to draw what the paper will look like when you unfold it.

(source: Math for Smarty Pants, Marilyn Burns.)

Pizza Pizza

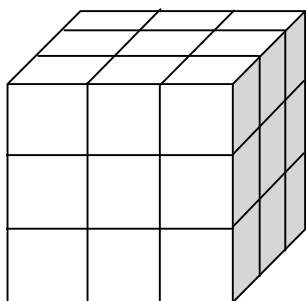


If the price is the same, which is a better buy – a round pizza with a diameter of ten inches, or a nine-inch square pizza?

Cube Puzzle

The following activity is a great one to include when studying surface area and volume.

To prepare for the activity, you will need at least 27 small wooden cubes, available in craft stores (and in the unfinished furniture store in Exeter). I used the one-inch size. Arrange them to form a 3x3x3 cube like this:



Then carefully paint the outside of this cube.

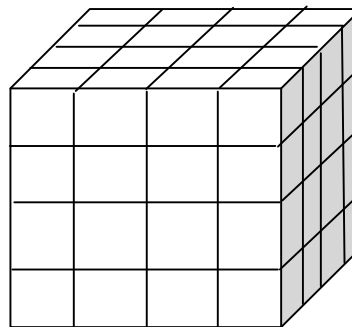
Bring this cube to class, unassembled, in a baggie. Explain that you built a 3x3 cube, painted the outside, and took it apart, and challenge them to figure out:

- How many of the small cubes don't have any paint on them? (1)
- How many of the small cubes have paint on exactly one side? (6)
- How many have paint on two sides? (12)
- On three sides? (8)
- On more than three sides? (none)

After making their predictions, have them assemble the cubes to make the 3x3x3 cube (this is not as easy as it sounds!) If you have a lot of students, you may want to paint several sets. Students can check their predictions with the model.

You can also talk about the volume and the surface area of the cube, what fraction of the faces of the smaller cubes have paint on them, number of vertices, edges, etc.

Next, have students imagine that they are going to build a larger cube that is 4x4x4, like this:



Have your students predict the number of small cubes that have paint on 0 sides, 1 side, 2 sides, and 3 sides.

String Shapes

This activity helps students practice geometry-related vocabulary, and it never fails at getting everyone laughing.

Tie the ends of a 20-foot long piece of string together to form a big loop. Make one of these loops for each team of three or more students.

Team members stand in a circle and hold the string with both hands. You (or a student designated as the caller) call out the name of a geometric figure. The players on each team have to work cooperatively to form this shape with their string. The first group to do this successfully scores a point. Play seven rounds. The team with the most points at the end wins. *(continued on next page...)*

(String Shapes, cont.)

To score a point, all students must be holding the string with two hands. If there are 5 or more players on a team, you can change the rules so that students hold the string with only one hand.

Variations:

- a) The shapes can be written on cards, and teams take turns picking a card and forming the shape they pick. The other group times them, and the team with the shortest total after five turns wins.
- b) Instead of loops of string, teams can have two pieces of string, and can be asked to form different types of lines and angles.

Geometric Shapes

Triangle
Right triangle
Acute triangle
Obtuse triangle
Isosceles
triangle
Equilateral
triangle
Scalene triangle
Square
Rectangle
Parallelogram
Rhombus
Trapezoid
Pentagon
Hexagon
Two similar
triangles
A concave
polygon
Add your own!

Answers

Problem of the Month, p. 1

You need **20** fence posts. Convert the lengths of the sides to inches, and divide each side by 30. (Drawing a picture helps.)

Geometry of the Globe, p. 1

- A. London, England
- B. New York, NY
- C. Rio de Janeiro, Brazil
- D. Tokyo, Japan
- E. Melbourne, Australia
- F. San Francisco, CA
- G. Moscow, Russia
- H. Capetown, South Africa
- I. Buenos Aires, Argentina
- J. Reykjavik, Iceland

Pizza Pizza, page 2

The nine-inch square pizza.
 $81\text{in}^2 > 25\pi\text{in}^2 (\approx 78.5\text{in}^2)$

Web sites

The following sites have WONDERFUL interactive math activities, including many geometry activities. Take the time to check them out!

- [Shodor.org](http://www.shodor.org)
- [NCTM Illuminations](http://illuminations.nctm.org)
- [Internet4Classrooms](http://www.internet4classrooms.com)
- [National Library of Virtual Manipulatives](http://www.nationallibraryofvirtualmanipulatives.org)

I also recommend:

Polygon Angle Applet

This web site has an applet that lets you draw shapes and tally up their angle measurements. Cool!

<http://www.mste.uiuc.edu/java/java/angleobject/>

Quadrilateral Quest

Students can practice using the vocabulary associated with quadrilaterals and explore the properties of quadrilaterals at this interactive site.

http://teams.lacoe.edu/documentation/classrooms/amy/geometry/6-8/activities/new_quads/quad1.html

Polygon Sorting Activities

This activity ties in the idea of polygon relationships with the use of Venn diagrams.

<http://illuminations.nctm.org/LessonDetail.aspx?id=L270>

What's Your Angle?

In this lesson plan, students use "angle wheels" to estimate angle measures.

http://www.pbs.org/teachersource/mathline/lessonplans/msmp/angle/angle_procedure.shtm

Bathroom Tiles – This is a very cool activity that allows students to explore **transformations**:

<http://www.bbc.co.uk/education/mathsfilere/shockwave/games/bathroom.html>

I do not have a big box of **centimeter cubes** and this is a great way to help students see different views.

<http://illuminations.nctm.org/ActivityDetail.aspx?ID=125>

Isometric Drawing Tool

<http://illuminations.nctm.org/ActivityDetail.aspx?ID=125>

Discovering Pi

<http://www.eduref.org/cgi-bin/printlessons.cgi/Virtual/Lessons/Mathematics/Geometry/GEO0001.html>

Shape Explorer

<http://www.shodor.org/interactivate/activities/perimeter/index.html>

Polyominoes

<http://math.rice.edu/~lanius/>

Cylinder Problem

<http://math.rice.edu/~lanius/Geom/cyls.html>

Mask project – a great way to practice **transformations** in a fun hands-on way.

<http://www.k12.hi.us/~mathappl/dina.htm>