“Building a Geometric City”

For further information contact…

Robin W. Collins
Jesse Keen Elementary
815 Plateau Ave.
Lakeland, Florida  33815
(863) 499-2880
robin.collins@polk-fl.net

■ PROGRAM OVERVIEW

Building a Geometric City is a program that allows hands-on learning experience for the students as they come to the end of their geometry unit in math class. Using Shape Bait to introduce geometric shapes, terms and descriptions as a daily 5-10 minute exercise for a month helps prepare the students for what they will do in this program. Students take the information they have learned and put it into action by learning to build a city blueprint using geometric figures to fill land quadrants, four in all, along with geometric terms and descriptions to describe what they have designed. As students work on their geometric city they will use manipulatives such as pentominoes, snapping blocks (cubes) and pattern blocks. They will use geo dot, isodot, and grid paper as they design specific buildings for their city. The nice thing about this project is that you can make it as detailed or as simple as you wish to make it in order to fit the needs of your students. This program can be adapted to about any grade level by adding or taking away parts of the assignments.

As students learn to use different polygons for buildings and designs they will also be taking photographs of different polygon shapes around the school. To make this part of the project fun they can take a field trip to the mall to look for polygon and non-polygon figures. (They are not allowed to take pictures of the different store fronts while at the mall though.) The pictures will be placed on a display board and students will use mathematical reasoning as they label the pictures. Once the displays are finished each team will give an oral presentation describing their display and their mathematical reasoning for the display of pictures.

The instructional objective to this project is to have the students work in teams and use the information they have learned from their geometry unit in math class as they design their own geometric city. The skills the students will learn are mathematical reasoning, the ability to determine outer boundaries of a city, to design and place regular and irregular polygon and non-polygon buildings within the boundaries of the four quadrants in their city. Students will also use snapping blocks (cubes) to design a particular building and then attempt to draw a 3-D picture of the building using geodot or isodot paper.

The time line for this project depends mostly on the students in the class and how well they grasp the concept. It will take my class at least 10 or more school days to finish this project working 90 minutes a day during the FCAT testing weeks. Some classes may take less time.

■ OVERALL VALUE

The innovative approach to teaching this concept is getting students to take what they have learned and apply it to a real-world experience of what an architect, a landscape designer or even city planners do in their daily jobs. To build something with your own hands or design a building or landscape around a building is a real-world experience that may capture a student’s enthusiasm for what they want to do with their future.

The students that have participated in this activity are a group of fifteen 4th graders. At least 85% of the students are ADD/HD students working on grade level but at different paces. The program is done as a whole class for instruction and then they work in teams of three or four. I had three groups of four and one group of three that worked together to design four different cities. The program can be implemented with different class levels pacing the levels at a pace they are able to work at. The program can be adjusted to fit the learning styles and abilities of the students. It is flexible and easily rearranged as parts are dropped, adjusted, or added to.

■ LESSON PLAN TITLES

• Finding the Outer Boundaries of a Geometric City
• Designing a Polygon Reflection Pond
• Building a Hospital (or other building) using Connecting Cubes

■ MATERIALS

Materials for each lesson are listed with each lesson plan. Overall materials budget including pricing and vendors follows the lesson plans.

■ ABOUT THE DEVELOPER

Robin Collins graduated from Freedom Univ. (Florida) with a B.S. in Education. She also received a Master’s Degree (M.S.) from Nova Southeastern Univ. (Florida) in Education: Teaching and Learning.

Robin has taught in Lakeland for the past 27 years. Her first 21 years of teaching was at Temple Christian School where she taught pre-school for 7 years, 3rd grade for 11 years and then 4th grade for 3 years. She spent the next six years at The APPLE School teaching 4th grade.

This is Robin’s first grant from the Teacher-to-Teacher connection.
**SUBJECTS COVERED**
Math and Geometry

**GRADES**
4th grade, but it can be adjusted to just about any grade level by adding or deleting from the lesson plans.

**OBJECTIVES**
Students will be able to determine the outer boundaries of a city with an area of 44 square miles with at least 85% accuracy. The students will also be able to find the center of the city using the x – y axis, and then divide it into four quadrants with at least 80% accuracy.

**SUNSHINE STATE STANDARDS**
MA.A.1.3.4 The students will construct, interpret, and use drawings such as those based on number lines and maps to solve real-world problems.
MA.C.3.3.1 The students will use coordinate geometry to locate objects in both two and three dimensions and to describe objects algebraically.

**MATERIALS**
- GSP Software (Geometer’s Sketchpad) optional for grades 5 and higher
- Grid Rule Chart Tablet (1 page per team with extra pages for those needing to start over)
- Pencils, colored pencils and markers
- Instant camera per group

**DIRECTIONS**
- Students are to determine as a group the boundaries of their city. The city is to be 44 square miles. Scale for chart paper: 1 sq. in. = 1 sq. mile. The size of the city can be altered as desired by the teacher.
- When determining the boundaries students will design the city boundaries using any polygon shape having more than four sides with no right angles.
- Students must give their city a name using the geometric characteristics of its boundaries as a guide when choosing the name. Students must be able to justify the name of their city. Why did they choose the name they chose, using geometric terms to describe their choice of name?
- My class will be taking a field trip to the mall. A field trip request form will be put in for a trip at the beginning of our geometric city program. (When we went to the Lakeland Square Mall we were told by the security guard that we were not allowed to take pictures of the store fronts so keep this in mind. Maybe a trip to an outside mall such as the new one located on Harden Blvd would be a better choice.).

**Photographic Log**
The different teams will be given an instant camera that they will use during the program to take pictures of geometric shapes and forms. These pictures can be taken around the school campus, at home or while on a field trip to the mall. The pictures must have mathematical concepts related to them. Students will need to list their pictures and be able to tell how a mathematical concept relates to each picture. The photographic log will be an activity that the students will work on throughout the geometric city project. The presentation will be done at the end of the program.

**EVALUATION/ASSESSMENT**
Have students complete a scale drawing on 8½ x 11 grid paper of the boundaries of their geometric city and how they divided it into 4 quadrants. Did their boundaries show a polygon with more than 4 sides and no right angles? Did they find the center of the city?

**ADDL INFORMATION**

**Field Trip:** Take a day while working on this project and go to the Mall and allow students to take pictures of things that represent geometric shapes.
**SUBJECTS COVERED**
Math and Geometry

**GRADES**
4th grade, but it can be adjusted to just about any grade level by adding or deleting from the lesson plans.

**OBJECTIVES**
Students will be able to draw symmetrical polygons, determine areas and perimeters of asymmetrical polygons and place reflected shapes in quadrants using ordered pairs with at least 80% accuracy.

**SUNSHINE STATE STANDARDS**
MA.C.2.2.2 Identifies and performs flips, slides and turns using concrete and graphic materials
MA.C.3.3.1 Represents and applies geometric properties and relationships to solve real-world and mathematical problems.
MA.C.3.3.2 Identifies and plots ordered pairs in all four quadrants of a rectangular coordinate system (graph) and applies simple properties of lines.

**MATERIALS**
- Grid Rule Chart Paper with Geometric City drawn on it
- Pencils, colored pencils and markers
- Reflection Pool Dot Paper
- Instant camera per group

**DIRECTIONS**
- Students will design an asymmetrical (irregular) (designing it asymmetrical is optional) polygon reflection pond so that its vertices fall on the vertices of the grid paper.
- As a team the students will determine the area and perimeter of their polygon pool.
- Once the perimeter and area of the polygon pool have been determined students are to make a pattern of it. They are to draw the 1st pond in the 1st quadrant remembering to locate it so that its reflection can be drawn in quadrant 2. Then a reflection of pond 2 can be drawn in quadrant 3 with a reflection of pond 3 being drawn in quadrant 4. Students will use flip, slide and turn to place their ponds so that each one is a reflection of the one before it.
- When planning the layout of the reflection ponds the students are to place them as far away from each other as possible while having them fit within the boundaries of the city.
- Students will use reflection pool dot paper to design their reflection pond.

**PHOTOGRAPHIC LOG**
Students should take pictures that show reflection with a mathematical reason. Students can take these pictures at the Mall later in the week or with teacher’s digital camera.

**EVALUATION/ASSESSMENT**
Have students use the scale drawing of the boundaries of their geometric city and draw the reflection ponds in the 4 quadrants showing flip, slide and turn.

**ADDL INFORMATION**
Geo dot and Isodot paper can be found in most mathematical resource books that come with the standard math curriculum.

★★★★
“Building a Geometric City” Robin Collins
Lesson Plan No 3:
Building a Hospital (or other building) Using Connecting Cubes

**SUBJECTS COVERED**
Math and Geometry

**GRADES**
4th grade, but it can be adjusted to just about any grade level by adding or deleting from the lesson plans

**OBJECTIVES**
Students will be able to locate points on a coordinate plane for given ordered pairs with at least 85% accuracy. Using connecting cubes students will be able to model a building of their team’s design with at least 90% accuracy. Students will then use triangular or isodot paper to practice drawing a 2-dimensional representation of a 3-dimensional figure. Students will be given an opportunity to build a 3-dimensional figure using a 2-dimensional drawing provided by the teacher as practice.

**MATERIALS**
• Connecting Cubes
• Triangular or Isodot Paper
• Chart paper with city boundaries labeled with ordered pairs, both positive and negative.
• Display board or poster board (get from school resources or students provide)

**DIRECTIONS**
• Use one set of ordered pairs for the location of the hospital in the Geo City:
  (-5, -1) & (-5, -3)
  (6, 0) & (4, -3)
  (3, 1) & (1, 3)
  (-2, 3) & (-4, 3) or
  (0, 0) & (1, 1)
• Using connecting cubes teams are to model the hospital for their city. Each layer of cubes represents a floor of the hospital.
• After the hospital has been built, students will use triangular dot or isodot paper to try drawing the top, sides, and front views of their hospital.
• Teams will use a 2-dimensional drawing provided by the teacher to build the 3-dimensional figure in the drawing.
• Connecting cubes can be used to design other buildings such as schools, stores, police stations, gas stations, etc. Use geo dot paper or triangular dot paper to draw the views of the buildings and to get a pattern for the placement of the buildings on the chart grid paper. (Optional or for extra practice).

**EVALUATION/ASSESSMENT**
Have students write a description of the figure which was built by their team using appropriate geometric vocabulary.

**SUNSHINE STATE STANDARDS**
MA.C.1.2.1 Draws and models two- and three-dimensional shapes and uses appropriate geometric vocabulary to write a description of a figure or a picture composed of geometric figures.
MA.C.3.3.1 Represents and applies geometric properties and relationships to solve real-world and mathematical problems.
MA.C.3.3.2 Identifies and plots ordered pairs in all four quadrants of a rectangular coordinate system (graph) and applies simple properties of lines.

Students will choose sets of coordinates listed above to place their buildings on the grid chart paper within the boundaries.
• If designing their own buildings proves to be too much for the students they can use pintominoes to trace for the designs of the buildings.

Photographic Log
Once pictures on cameras are complete and developed students should begin putting together their display of photos. A title should be given and each picture should have a mathematical description of the geometric shape represented in each picture. Students may use clip are to help decorate their display as well as border.

2006 - 2007 IDEA CATALOG OF EXCELLENCE
Pre-preparation Lessons for Building a Geometric City

In order to help my students learn how to use geometric terms and descriptions accurately, I began using Shape Bait a month before using the Geometric City lessons.

I made a book for the students where they would draw the shapes and use as many geometric terms as possible to describe that particular shape. We took a shape a day. Shapes could vary just in size, but they would still have to describe it again. The repetition helped them become familiar with the terms when describing shapes.

EXAMPLE:

Square: A square is a polygon with 4 equal sides and 4 vertices. It is also a quadrilateral. It has 2 sets of parallel lines, one vertical and one horizontal. The square has 4 lines of symmetry. It has 4 right angles. When you fold it in half one time, it makes a triangle with 1 right angle or a rectangle with 4 right angles.

This activity takes about 5 - 10 minutes out of your day, but it works wonders when helping the students learn geometric terms and learn how to recognize and describe shapes.

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### Geodot Paper for Geoboards

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Name ____________________________
Isodot Paper

Example
## Materials Budget

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<th>ITEM DESCRIPTION</th>
<th>QTY</th>
<th>COST</th>
<th>SUPPLIER</th>
<th>TOTAL COST</th>
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<tr>
<td>Geometer’s Sketchpad (Optional) Software</td>
<td>1</td>
<td>$49.99</td>
<td>Online at <a href="http://www.keypress.com/sketchpad/">www.keypress.com/sketchpad/</a></td>
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<td>Graph Chart Paper Tablet</td>
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<td>Teacher’s Exchange*</td>
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<td>Bucket of Pentominos (72 Count)</td>
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<td>$14.95</td>
<td>Teacher’s Exchange*</td>
<td>$14.95</td>
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<tr>
<td>Attribute (Pattern) Blocks (p. 10)</td>
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<td>CHILDCRAFT Education Corp**</td>
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<tr>
<td>Childcraft Linking Cubes (p. 11) (160 pcs/set)</td>
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<td>CHILDCRAFT Education Corp**</td>
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<td>Disposable Cameras (Optional) (1 per Team)</td>
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<td>$19.80 + tax</td>
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<td>Developing of Cameras (Optional) (sgl print)</td>
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<td>$4.38</td>
<td>Wal Mart</td>
<td>$17.52 + tax</td>
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** Teachers Exchange:  
1065 S. Florida Ave., Lakeland

** CHILDCRAFT (Spring 2006) Education Corp.:  
PO Box 3239, Lancaster, PA 17604  
www.childcraft.com  
1-800-631-5652

Items such as colored pencils, markers, glue and construction paper may be obtained through the school or student supplies. Also, the Shape Bait program can be purchased in place of any item on the list.

Teacher’s Name          ** Robin W. Collins **
School:                  ** Jesse Keen Elementary **

Subtotal $203.11
Tax if applicable (See Below)
Shipping if applicable

TOTAL BUDGET AMOUNT $203.11

(Use school tax code to avoid paying taxes and be ready to pay for developing of one roll of film.)