Mathematics Unit Plan for Sixth grade

For the lesson on January 12, 2004
At St. Josaphat School, Ms. Naughton's Class
Instructor: Ms. Katie Naughton
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1. Title of the Unit: Finding the Area and Perimeter of Polygons
   Goal of the Unit:
   > Students will deepen their understanding of area and perimeter of two-dimensional objects, and experience the independent nature of area and perimeter in a problem solving sense.
   > Using the experience of the problem-solving lesson, students will develop formulas for area and perimeter of triangle, parallelogram, and trapezoid.
   > Students will compute the area and perimeter of a square, rectangle, right triangle, parallelogram, and trapezoid as separate shapes, as well as a combined polygon created by each student.
   > Students will be able to multiply findings of area and perimeter by decimals to determine cost.

   Relationship of the Unit to the Illinois Learning Standards for Mathematics.

Related Measurement Standards for Late Elementary:

STATE GOAL #7: Estimate, make and use measurements of objects, quantities, and relationships and determine acceptable levels of accuracy.

> Measure and compare quantities using appropriate units, instruments, and methods.
> 7.A.2a Calculate, compare and convert length, perimeter, and area within customary and metric systems
> Select and use appropriate technology, instruments, and formulas to solve problems, interpret results, and communicate findings.
> 7.C.2a   Describe relationships in a simple scale drawing.
> 7.C.2b   Construct or draw figures with given perimeters and areas.

This Lesson

Related Measurement Standards for Middle/Junior High:

STATE GOAL #7: Estimate, make and use measurements of objects, quantities, and relationships and determine acceptable levels of accuracy.

> Measure and compare quantities using appropriate units, instruments, and methods.
> 7.A.3b Apply the concepts and attributes of length, perimeter, and area in practical situations.
> Select and use appropriate technology, instruments, and formulas to solve problems, interpret results, and communicate findings.
> 7.C.3b Use concrete and graphic models and appropriate formulas to find perimeters and areas of two- and three- dimensional regions

Instruction of the Lesson

Geometry is an area that lends itself to lesson study, because of the problem solving nature of the discipline and because of the need for highly-reflective learning opportunities for students. Students have struggled in the past retaining the knowledge from one year to the next. Ideally, students come into the sixth grade knowing what area and perimeter are and knowing how to compute the area and perimeter of a square and a rectangle. In our experience, however, students to do not retain this information from year to year, and we, therefore, have to reteach the formulas before moving forward. By allowing students the opportunity to experience the shapes before presenting formulas with which they can simply plug in given numbers, our hope is that this experience will be meaningful enough to encourage retention and a deeper understanding of the process.

Through this unit, we want students to explore and develop the area formulas for the following shapes: triangle, parallelogram, and trapezoid. Students will brainstorm and activate prior knowledge in the first lesson, and then build upon this prior knowledge for the remainder of the unit. Students will make informal connections between shapes through the use of manipulatives and create relationships among the geometric shapes named above. For the first three days of the unit, students will review what they know about squares and rectangles, use this knowledge to make connections to the remaining shapes, and discover relationships among them. On the fourth day of the unit, students will be given an activity that will help them tie that information together and use it in developing the necessary area formulas.

In order to develop a formula, students need two things. First, they need to understand the properties and characteristics of the shapes that they are working with. On the second day of the unit, we will be identifying and discussing what makes each shape the shape that it is: What is it about a rectangle that makes it a rectangle? Why is a trapezoid different than a parallelogram? This will provide the students with the capacity to discuss the shapes in a formal way, considering the actual properties of the given shapes. The second thing that students need to develop a formula is a basic, general notion of what area and perimeter mean. On the second day of the unit, students will also be making connections among shapes – seeing what shapes it takes to cover a trapezoid completely, for example. This experience will get students thinking about area in the general sense of space being taken up by a shape. Finally, on the third day (the research lesson), students will be using complex shapes to understand that any polygon can be broken into recognizable portions and the area of a complex shape can be computed by adding up the area of each shape. Following that cumulative activity, students will be prepared to formulate their previous knowledge into the area formulas for the triangle, parallelogram, and trapezoid.

In studying geometry, we thought it would be best to provide the students with a practical, hands-on activity. We want students to be able to make connections among shapes and recognize how shapes are related to one another, including how certain shapes can be used to create others. We considered using tangrams or pattern blocks, but decided these were not the best choice. First, we wanted students to calculate the area and perimeter of a trapezoid, which is not included in the tangrams. We also wanted students to have access to a right triangle, which is not included in the pattern blocks. In order to best meet the needs of our students we made the decision to create our own set of shapes with dimensions we

could control, and that would, therefore allow the students to compute area and perimeter given their mathematical abilities at this point in their learning.

Unit Overview

Day 1: Exploring the School

What is a polygon? Which ones do we know?

Students will begin by brainstorming all of the shapes they know. They will be asked to draw and name each shape they come up with. Students will then be asked to find these shapes in different places around the room. Students will go on a geometry fact finding mission walk around the block. On their walk they will be asked to draw and name any familiar shapes they see. Students will recall the concepts of area and perimeter from previous learning. Students will define perimeter as the distance around an object and area as the amount of space that the object takes up. For homework, students will choose three of the shapes they found and tell what properties make them the shapes they are.

Day 2: Name that Shape

Properties and relationships of geometric shapes

The shapes focused on in this unit will be identified and drawn on the board. These will include, but not be limited to: square, rectangle, parallelogram, triangle, and trapezoid. Students will identify as a class the properties of each shape. What makes a square a square? Why is it different from a rectangle or triangle? Students should record properties and ideas in math notebook. Students will discuss the properties of different shapes and make observations about how different shapes are in relation to others. Students will be given the manipulatives (small, medium, and large right triangles, square, rectangle, parallelogram, and trapezoid) to be used in the research lesson and will be given time to become familiar with the shapes. Students will use knowledge of shapes and relationships among shapes to develop relationships among these given shapes. (i.e. two triangles make up one square.) For homework, students should research and record any and all relationships that they can find among these shapes. Then, students will combine the shapes into a polygon and paste the polygon on a piece of paper.

Day 3: Research Lesson See Lesson Plan

Day 4: Formula for the Area of a Square and Rectangle

Students will recall the information they know about sqaures and rectangles. They will generate the formulas for finding the area of a square and rectangle, which they should know from previous learning experiences. Students will practice using the formulas for finding the area of a square and rectangle. This will be done through the use of various materials, including geoboards.

Day 5: Formula for the Area of a Triangle

Students will review what they have worked on previously. From the dimensions that were determined, students will try to generate formulas for the given figures. Students will be given an example of a triangle with an area of 12.5 units squared. If the area of a square is 25 unites squared, and the formula for the area of a square is side squared, what would be the formula for the area of the triangle? For homework, students will practice finding the area of a triangle using this formula.

<u>Day 6: Formula for the Area of a Parallelogram</u>

    Students will review the previous day's lesson. From determined dimensions, students will try to generate a formula for finding the area of a parallelogram. For homework, students will practice finding the area of a parallelogram using the formula.
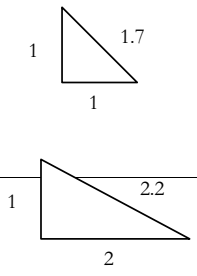
<u>Day 7: Formula for the Area of a Trapezoid</u>

    Students will review the previous lessons. From determined dimensions, and using relationships they know between figures, students will try to generate a formula for finding the area of a trapezoid. For homework, students will practice finding the area of a trapezoid using the formula.

<u>Day 8: Maximize Area and Perimeter</u>

    Students will review what they have learned so far in this unit. Students will be given two problems – one will maximize the area with a given perimeter. The other will minimize perimeter with a given area. Students will determine, through practice, that a square maximizes area while minimizing perimeter. Students may be asked to create two quadrilateral shapes that have the same perimeter, but different areas.

Learning Process (or Plan of Lesson)

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher's Support	Points of Evaluation
1. Introduction • Students take out their polygons and class discusses all of the different shapes created. Please see attached sheet for expected student shapes.	• Facilitate discussion and check completeness of all polygons	Do all students have polygons that are usable for activity?
2. Posing Problem		
The polygon that you have created is actually the design of your new garden! You have to lay down soil and make a brick border for your garden to get ready for spring! At Home Depot, they are running a special on soil – it is selling for $1.75 per square foot. How much does it cost to lay down soil in your garden? For the brick border, you go to Menard's because each brick, measuring one foot in length, costs only $.39. How much does it cost you to put a brick border around your garden?		
3. **Solving Problem** **Anticipated Student Solutions** There are two major avenues that students may take, using the small triangle as a unit: (1) Students may count the number of triangles that fit in the polygon as a whole. (2) Students may count the number of triangles that fit in each shape and add. • Students' notes from Day #2 may be sufficient to solve this problem. • Students may ask for a ruler, but they will be reminded that the measurements that	• Teacher provides students with the following information: The only measurements that you may need are the following:	For the purposes of the first question asked, regarding the area of the figure, students will only be given the unit measure 1 of the bottom of the small triangle. With that information, will students be able to compute the area of the polygon? Can students make the connection between the

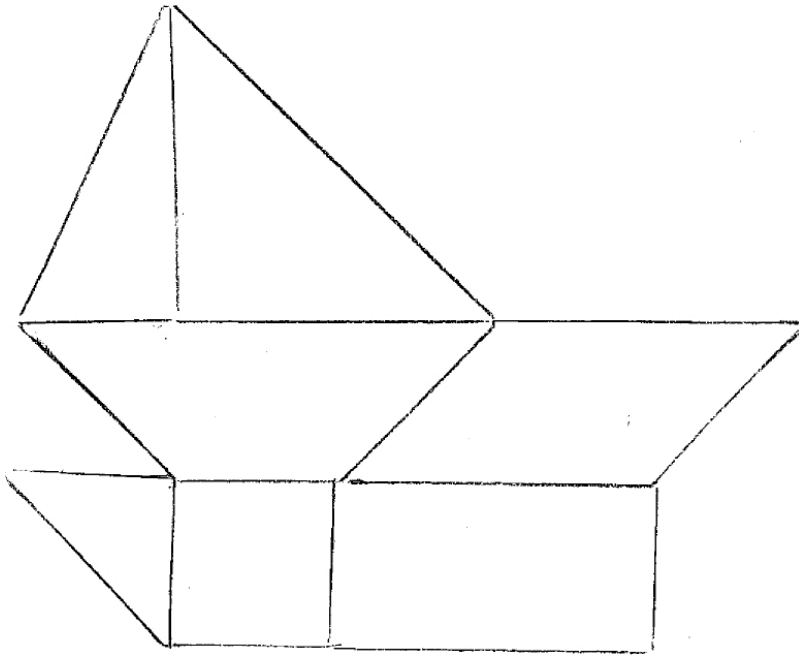|		
they need have been given. • Students may ask for another unit triangle, which will be available upon request. Students may then use that extra unit triangle to count the triangles in the polygon.		number of triangles each shape is made of and the area of the shape?

4. Comparing and Discussing
 	
• Students will be given the time to work with a partner in computing the area of their individual polygons.
• Once students compute the area of the polygon, they will need to compute the cost by multiplying the area by the cost of the soil per square foot.
• Groups of students will be called up to the overhead to explain their solutions.
   - Some students may suggest that it is coincidence that the areas turned out equal even though the shapes are different.
   - Discussion will lead students to recognize that two figures made out of identical shapes will result in identical areas.
   - Students should agree that the different shapes will produce the same area.
   - Students should understand how perimeter and area are computed independently of each other.
	• The two groups of the students called up will represent the two methods of solution discussed above.
	• Because we will try and make the connection between this activity and the area formulas of the individual shapes, teacher will support more fully the process in which students use the unit triangle to find the area of each individual shape.
		Are there any groups that were completely stuck as to how to solve the problem?
		
		Do all groups of students actually compute the same cost for the soil?
		
		Do all groups of students understand the two methods of solving this problem?
		
		Does the class agree that the method which uses the triangle with the individual shapes allows us to more clearly see the relationships between these shapes that we are trying to learn more about?

5. Summing up • Students, still working with their neighbors, are now given the second portion of the problem – concerning the cost of bricks to go around the outside of the garden. Students work with neighbor to compute the perimeter of their garden. • If time permits, student groups can be called to the board to discuss their different costs.	• Here, students will be given the remaining information on necessary measurements, but it will be stressed that these measurements may only be used by some groups and not others.	Are students able to use the relationships from Day #2 and the work that they have done in Step #1 of the problem to accurately compute the perimeter of the polygon?

Evaluation

Whether it occurs in the "Summing Up" portion of Day #2 or on the next day, ultimately the goal of the lesson is to allow students to experience the independent nature of area and perimeter. In this problem, as the figure changes shape, all students find that the area of the polygon remains the same, because each figure, no

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matter what the shape, is created out of the same seven shapes. The perimeter of the polygon is the number that changes depending upon the shape of the figure. In this case, while area remains constant, the perimeter changes depending upon the compactness of the figure created by each student.

Students will explore which shapes have the smallest and largest perimeter. Then, they can make correlation between the kind of shapes and the size of the perimeter, namely the more compact the shape, the smaller the perimeter. In this case, a more practical connection can be made between the shape and the cost of their garden showing students that this information is relevant in their real lives.