Improving Teacher Quality Program

Mathematics Within: Algebraic Processes and Its Connections to ***Geometry***

Erik Swenson

Context of the lesson:

1. ***Explain where this lesson occurs within a unit or series of lessons. Describe what led up to this lesson and what will follow.***
   Before entering fifth grade, students will have had previous experience with area, perimeter and multiplication. Before this lesson, students will have completed a unit on area using area models and other means to describe the area of a rectangle, so this lesson comes as a culminating activity to wrap-up our unit.

   This lesson was originally created for third grade and can be found in *Investigations in Number, Data, and Space*, TERC, Dale Seymour Publications. I teach Title I to fifth graders, and since my students are working below grade level, this lesson should be at their level and should set them up to find success with their math and help them feel good about their efforts, so that they feel confident about working with math in the future.

2. ***What is the purpose of this lesson?***
   To assess students' understanding of area, perimeter, and multiplication, and test their higher-order thinking skills as they work with proportion and number sense.

3. ***What do you anticipate taking place?***
   Using centimeter grid paper, students will draw and cut out a humanoid figure, called a Balobby, no less than 5 cm and no more than 8 cm. Aluminum foil will be twisted together and fashioned to represent a three-dimensional replica of this Balobby. Large roll paper will be provided with specific dimensions for the land. Students will pretend they are city planners and will be given centimeter grid paper to cut into living spaces that will occupy this land and fit together proportionally, and options for living spaces will be provided. Base ten centimeter blocks will be provided for scale purposes and students will constantly be asked the question "Does this make sense?" This lesson will take several days. Students will work in small groups and will be encouraged to use any resources at their disposal to reason about the area of the space they are creating and its relative size to their Balobby and other structures.

4. ***What strategies or techniques will you use to monitor learning?***
   The teacher will observe students creating these living spaces and asking questions about the "reasonableness" of a structure as they are planning the layout of this city. Under certain constraints, students will draw their creations and label them

appropriately. Students must be prepared to defend their reasoning behind why their creations make sense.

5. ***How will you know if students have achieved the objective(s)?***
   They will show me during the project that they understand how to find the surface area of an object and how far the distance around that object is and how it fits into a city, relative to other objects in that space.

   The end result will show me if students understand the concepts. As I observe them working on this project, their skills will become evident. They should be excited and motivated as they work, and I expect higher-level students to help lower-level students, which is why I wand them to work in small groups so they can decide together if an idea seems reasonable.

Improving Teacher Quality Program

Mathematics Within: Algebraic Processes and Its Connections to Geometry

Erik Swenson

Broad Topic: Geometry **Subtopic:** Multiplication, Area, Perimeter, Proportion, and Number Sense

Grade Level: 5 **Time Frame:** Five 30-minute lessons

Aim: To adapt the concept of "Balobbyland" to allow students to become city planners (for a week) as an assessment tool for them to show me their knowledge of Multiplication, Area, Perimeter, Proportion, and Number Sense.

Specific Objectives:

- Understand what students have learned about Area and Perimeter using area models and rectangular shapes
- See if they can use a limited amount of space and certain rules or constraints to build a "mini-city" that spatially makes sense – that is to say, each space that is used for a different purpose is proportional to the size of the Balobby person they made at the beginning of the lesson
- Provide students with a real-life application that will help them see the true value of studying Area, Perimeter and how this knowledge will help them in their everyday lives
- Prod their higher order thinking skills to see if they can take the concepts of area and perimeter, under constraints and with a given size of a person, to consider whether proposed rooms and spaces make logical sense relative to each other and how they are positioned within the confines of the city.

Materials/Supplies:

- Large Roll Sheet Paper (preferably green, approximately 1 meter by 2 meters). Because I am using this project as a small group activity for six or fewer students, you may wish to adjust the size of this sheet for an entire classroom.
- Plenty of Centimeter Grid Paper Templates: Stack of 50 standard-size ($8\frac{1}{2}$ x 11 inch) sheets each of white, blue, yellow, and pink. You can always copy more if you deem necessary, but start out with this amount. Any leftover sheets can always be used for next year's class(es).
- Pencils
- Black Markers
- Scissors
- Glue Sticks (better than bottles of glue in my opinion – less mess!)
- Base ten blocks (bit = 1 cm^3 cube, skinny = 10 cm^3 strip, flat = 100 cm^3 square, pack = 1000 cm^3 cube)

- Aluminum Foil

References:

- Balobbyland packet, adapted from Investigations in Number, Data, and Space, TERC, Dale Seymour Publications

Introduction

1. Review previous lessons on area and perimeter. Ask students if they were a carpet layer, how would they know how much carpet would fill up the floor? Since students have already finished a unit on Area and Perimeter, they should know that they can make an Area Model to represent the space that the carpet would cover. Knowing this will help them figure out the total area, such as a room with dimensions 25 feet x 13 feet:

Feet	20	+	5
10	200		50
+			
3	60		15

Splitting up the dimensions into two sets of convenient numbers is much easier to multiply than keeping the numbers larger. So, 20 x 10 = 200, 20 x 3 = 60, 5 x 10 = 50, and 5 x 3 = 15. Add up the products and you get 325 square feet. Multiplying with convenient numbers also helps students develop mental math skills.

2. Discuss concepts like Bird's Eye View, 2-Dimensional, Rectangular-Shaped, and Proportion.
3. Pose questions and discuss "Do you think your classroom is big enough for all the students in your classroom?" and "Why is our cafeteria as big as it is? Would it make sense to make the cafeteria three times as big as it is now, or three times as small?" and most of all, **"Does this make sense??"**
4. Let students know that you will be exploring how area and perimeter affect our daily lives, and that they will be getting a chance to pretend they are city planners for a place called "Balobbyland." Balobbyland is an imaginary community that they create in their own vision, after creating Balobbies.

Body

1. Hand out centimeter graph paper and model how to draw a figurine that is at least 5 centimeters tall but no taller than 8 centimeters, and no wider than 3 centimeters, no thinner than 2 centimeters. Cut the Balobby out and take a sheet of aluminum foil and fashion it into a humanoid shape as best as possible, with the same height and width as the figure you drew. Explain that a Balobby is a humanoid who particularly likes living in

treehouses. Their favorite pets are bears and they prepare their meals in something called a "Futurkitch". This intro should perk their interest and serve as a good anticipatory set.

2. Students will divide into small groups of no more than three so that they can share ideas and discuss challenges. Balobbyland city planners only have a certain amount of space with which to plan their community. Provide a green sheet of large roll paper, approximately 1 meter by 1.5 meters. This is the land you will use for development of the community. I chose Balobbyland to be this big because I work with small groups of no more than six, but you can add meters to the length depending on the size of the class and how many city planners you have and Balobbies are created.
3. Discuss the idea of "bird's eye view". If you were a bird or in an airplane flying directly over the city and directly above these buildings, how would they look? What does "two-dimensional" mean? When we create area models for rectangles, what are the "dimensions" of the rectangle? Explain that when we talk about something that is two-dimensional, we are only considering its length and width – not its height or depth (the third dimension)
4. With this much land, there can be no more than seven living spaces and no fewer than five. A living space is defined as any place where Balobbies spend their time together in small or large groups (i.e. swimming pools, sports arenas, treehouses, Futurkitch, etc.) Use pictures of previous Balobbyland projects (see pp. 8 & 9) or actual displays from previous years to model what the finished product will look like.
5. The important thing to stress when deciding on a living space and how large it will be is **"Does this <u>make sense</u> considering <u>how big</u> a Balobby is and <u>how many</u> should be able to fit into this space?"**
6. White grid paper should be used to show living spaces and insides of normal living rooms. Blue should be used for any bodies of water, rivers, etc. Light green should be used for parks. Yellow should be used for sports facilities. Red or pink should be used to show furniture and other items inside of living spaces.
7. All living spaces and furniture and any object must be in the form of a rectangle. **<u>Everything</u> in the community must be labeled with its dimensions to show what surface area it covers.** (Even the whole Balobbyland itself!)
8. Model how to cut the centimeter graph paper and tape (or glue stick) them together to make larger areas and rectangles. Ask students if they know how we might find the area of this space we just made. If we count 28 centimeters for the length and 54 for the width, how would we calculate its area? Wait for students to mention the area models and breaking the two-digit numbers up into convenient numbers and drawing the area model to help see the different components that we would multiply to find the different products that we would add together. They should remember this from previous area lessons and the review we did earlier. How many Balobbies could we fit into a space this big? What sort of furniture should we put into it? What kinds of roads will you build outside of this place to connect it with other places? Will the roads be big enough to allow a Balloby and his car to drive down the street with enough space?
9. Some ideas for living spaces:

- **Treehouses:** most treehouses are about 18 centimeters by 35 centimeters. Balobbies spend most of their time in these rooms. They sleep, read, play games, and do just about anything here. Use white grid paper.
- **Futurkitch:** about 15 by 25 centimeters. A large kitchen area complete with all the modern amenities – even a robot (3 x 3) that helps clean up and cook meals! Use white grid paper.
- **Swimming pools:** a 34 by 72 cm pool complete with diving boards and water slides on the side. A changing station may be included on the side (25 by 25 cm) with sides for boys and girls. Use blue grid paper for the pool and white for the changing station.
- **Sports arenas:** the largest of all spaces, these monstrosities boast dimensions of 56 by 98 cm, with outside parking lots connected. Use yellow grid paper.
- **Balobby libraries:** a place where Balobbies go to study or read, these places are 36 by 48 cm. Use white grid paper.
- **Parks:** Balobbies have to have somewhere to go after school or on the weekends with their pets and families, so these 37 by 22 cm spaces work well. Use green grid paper.
- **Businesses:** Office space measuring 24 by 36 cm where some mom and dad Balobbies go to work during the day. Use white grid paper.
- **Balobby school:** the learning center for Balobby children measuring 46 by 87 cm. Use white grid paper.
- **Restaurants, post offices, government buildings, etc.** . . . or whichever buildings they can dream up within reason, as long as they are at least 15 by 15 cm and no larger that 100 cm on any side. Use white grid paper. Remember though, they can't be too big or else they may not fit all their living spaces into the confines of the land!!
- **Roads and skyway systems:** there must be roads in between the living spaces and if not, students must be prepared to explain their reasoning for why two or more buildings were built right next to each other. I always encourage the use of skyway systems, and use Minneapolis' skyway system as an example (if they've ever been downtown). You can ask students who have been to downtown Minneapolis to describe the skyway system to other students who haven't been there.

10. While students are designing their structures, they should be encouraged to use base ten blocks with cubic centimeter units for stacking on their two-dimensional drawings to see what their buildings actually look like in three dimensions. Stacking "packs, flats, skinnies and bits" (terminology we use from the *Math Trailblazers* curriculum) on their drawings to a reasonable height and then comparing the three-dimensional structures to their Balobbies will give them a better sense of what is "reasonable" when considering what the floor area of each living space should be.
11. ***Always*** monitor students' work and be asking probing questions to see if their ideas make sense proportionally. Ask them to visualize themselves in a similar structure, assuming one centimeter from Balobbyland equals one foot in real-life.
12. This project should take about five 30-minute lessons (or three 50-minute lessons) in order to give them enough time to complete the work. They can use whatever markers or crayons to decorate the city or embellish it in any way, as long as they label each living space and any

furniture with its name and dimensions. Balobbies should be taped or glued or stapled down to the city in an "action pose."

Close

When the project is completed, it can be hung in the room or outside in the hallway using large black paper clips (see photos) and fish line, or simply use strong tape for the wall. Spend ten or fifteen minutes discussing parts of the project that were challenging and how students figured out how to solve certain problems. What did you like most about being a city planner? What did you like least? Students will be given time to reflect on this experience and write about it in their learning logs or journals.

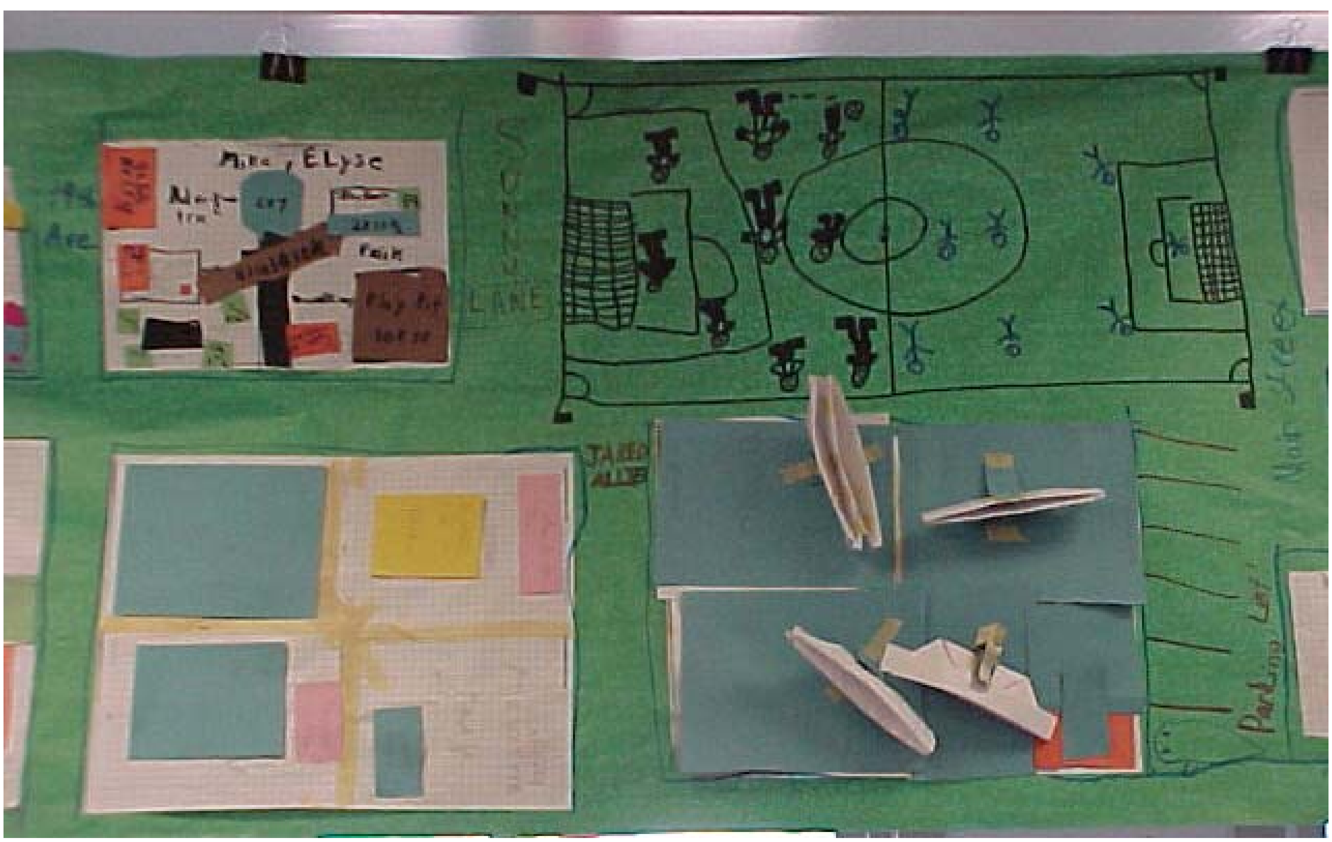
Application/Assessment

I will know how well students understand the concepts of area, perimeter, and multiplication by the work they show me when they write the dimensions of their objects in Balobbyland, and the reasoning they use to create these structures. Observations of their work will tell me if they can apply their knowledge of these concepts in situations that are related to their real lives. I will take down notes of their accomplishments and struggles during the project and any comments that I see fit.

Reflection

I use this lesson to teach and review a variety of concepts to my Title I students. The nice thing about this lesson is that students really can be creative and have fun with it. I can see the motivation in their eyes when they are working on this project and the sense of accomplishment when they finish a room or a building. Using a lesson like this sets students up for success because it's not that difficult for them (for 5th graders). When they finish it, they feel proud of their accomplishments and thus feel comfortable taking more risks with similar math concepts. Their confidence level goes up and they produce more quality work. My job as a Title I teacher is to help my students' performance get back up to grade level, and I believe this lesson really helps them get there.


Play Room
Lobby Drive


Mike , Elyse
Park
LANE
Parking Lot!


Balobby Road
Merrick Field
Touch Down!