Geometry Scaling Activity

Brenda Nelson and Michelle Stiller
Grades 7-12

Day 1:

Introduction of Similarity of Polygons:

Students will be working in groups of three. Each student will be instructed to draw various convex polygons using a straightedge. The instructor should encourage students to draw some polygons that are relatively small (fitting with a four square inch area) and some that are larger (filling an 8 ½" x 11" sheet of paper).

Prepare: A class discussion would take place to talk about what they already know about similarity and what they think may happen.

The teacher will then photo-copy the pictures, reducing the large ones and enlarging the small ones. (Note: use random percentages). The teacher will then return the original drawings and the photo-copied drawings to the students.

First Dare: Students would then work in their groups to come up with ideas about what happened with their polygons. Students would be given rulers and protractors – this may also help them with the idea that they should be measuring sides and angles. The teacher would be observing groups and helping with problems. Each group of students would write their results on the board.

Repair: The individual groups would present their observations to the class. The teacher would then summarize the information for the class: The angles are congruent and the sides are proportional or scaled. From this, the idea of Similarity is introduced. To help students really understand and to show another example, the teacher would draw a figure on the overhead. This figure would then be measured on the overhead as well as on the front board to show the similarities of the two shapes.

Share: The homework for that night would ask students to observe how similarities affect area. (See attached hand-out, **"WHAT'S MY AREA?"**)

Day 2:

Investigation into areas of similar polygons:

Share (continued): The students will share their findings about area to the class by presenting the information on the board. The class will then use the information to come to some general conclusions.

The teacher will introduce the concept of three dimensional figures (in spite of the fact that this is "Plane Geometry").

Prepare: Brainstorm with the students what we already know about areas and volume and similarities.

First Dare: Students will continue to work in their groups. Groups will be constructing a cube (hexahedron) and a tetrahedron (with the use of graph paper, compasses and straightedges) and then a second scaled model of each. They will be investigating what happens to the volume of the solids as the lengths of the sides change proportionally. Do the angles remain the same as they did with areas? Groups will present their findings at the board.

Repair: As a class we will look at what conclusions the groups came to. Adjustments will be made to help correct any errors. Students will also need to make drawings of their shapes

Share: The homework for the night will have students using their drawings to decide what happens to Surface Area of the shapes as the sides change proportionally.

Day 3:

Share (continued): The class will wrap up what the students found on their homework from the previous night.

*If students need a review in measurement, this would need to be added into the lesson plans.

Babies, Barbie's and GI Joe Activity:

This classic activity helps students understand proportions and how they are used incorrectly. Students will be using a baby doll, a Barbie Doll and an Action Figure to look at proportions between themselves (or an actual baby in the baby-doll case) and these items. They will build

proportions starting with different reference points. For example, the baby doll's weight will be compared to an average newborn's weight and then comparisons will be made. They may also try the same idea by starting with the doll and the newborns length.

(See attached activity guide, **"BABIES, BARBIE'S AND GI JOE"**)

At the end of this activity, the class will be discussing what they found.

Day 4:

Scale-Down Activity

In groups of three, the students will be working at creating a scaled drawing of the classroom. They will need to include everything in the room that is not moving. They will be responsible for creating a rough sketch of the room that they will make while taking measurements, a sheet of calculations and also a final sketch. They will need to pick an appropriate scale so that the room will fit on an 8 ½" by 11" sheet of paper. Students may use graph paper if they would like to.

(See attached directions and checklist, **"OUR ROOM REALLY MEASURES UP!"**)

Day 5:

Read in class the children's book, Cloudy With a Chance of Meatballs by Judi Barrett (ISBN 0-689-70749-5) to introduce the project.

Candy-Bar Project

Each student will be given a candy-bar wrapper (candy optional). They are to create a scaled version of their wrapper on butcher-block paper. They will also need to create a rough draft with measurements of the original wrapper. The scaled version will need to fill the butcher-block paper horizontally. The students should create as much detail as possible within the block.

(Directions and criteria for this activity are included in the attached project hand-out and Checkbric, **"WRAPPING IT ALL UP"**.)

WHAT'S MY AREA?

How does scale affect area of polygons?

You will need to hand in your graph paper and your written responses (on a separate sheet of paper).

1. Using graph paper, draw Quad ABCD {A(-2,2), B(3,2), C(-2,-1) and D(3,-1)}. Draw a new quadrilateral (A'B'C'D") proportional to the original by multiplying the coordinates of each significant point on the quadrilateral (the endpoints) by two. How do the areas of Quad ABCD and Quad A'B'C'D' compare?

2. Draw a right triangle on the coordinate plane around the origin (use graph paper). Do not place any sides along the x or y-axis. Label the endpoints and find the area. What do you THINK will happen to the area of a new triangle if you increase the sides of the triangle by three)? After you have answered this question, perform this operation.

3. Write a conjecture or a rule about how increasing the sides of a polygon affect its area.

4. Draw one additional example to support your theory.

5. Do you think the same will be true when you reduce the size of your polygon? Show two examples to show what happens.

BABIES, BARBIE'S AND GI JOE

An Activity in Proportions

You will be working with a partner for this activity. Each group needs to create proportions using a baby doll, a Barbie doll and a GI Joe action figure. They will then compute what each of these "mini's" would look like if they were actual babies, women and men. These calculations should be compared with what the average baby, woman and man look like.

Directions:

1. Create a data sheet for the information that you will be gathering
2. Gather supplies- measuring tape, scale, yard stick, string
3. Measure at least 8 parts of each figure (you must measure weight, height, foot length, waist and bottom of foot to waist length). Record your data.
4. Using the internet, find the average size of a baby, woman and man (you will need to find the 5 that I have listed plus the other 3 that you used).
5. Create a ratio of figures weight to actual average weight. Use this ratio to create proportions for the remaining parts. Compare the actual averages with the calculated average.
6. Repeat part 5 for at least 3 other original ratios. Compare.
7. Do steps 5 and 6 again with your measurements. Start with the height ratio.

Respond to the following (process your response):

How accurate was each of the figures? Which figure was truest to the actual average? What body part was most accurate in creating proportions? Were there any parts that were way off track? Discuss.

You will be presenting your findings to the class. Focus in on 2 or 3 general conclusions or things you found most interesting.

Hand In:

1. Data sheet
2. Written response

OUR ROOM REALLY MEASURES UP!

An Activity in Scaling Down

In groups of three, you will be working at creating a scaled drawing of the classroom. You will need to include everything in the room that is not moving! Make sure to not only look at how big things are but also how far they are from one another. You will be responsible for creating a rough sketch of the room while taking measurements, a sheet of calculations and also a final sketch. Make sure to pick an appropriate scale so that the room will fit on an 8 $\frac{1}{2}$" by 11" sheet of paper. You can use graph paper if you would like.

Criteria Checklist:

I have:

_____ measured and recorded all objects in room and their distance from one another

_____ had the teacher check my rough sketch prior to calculating anything (I'll initial this one☺)

_____ created a scaled drawing that fits on an 8 $\frac{1}{2}$" by 11" sheet of paper

_____ clearly shown all calculations

_____ used a straight edge on my final sketch

_____ included a scale on my final sketch

_____ handed in my rough sketch

_____ handed in my calculations

_____ handed in my final sketch

WRAPPING IT ALL UP

A Project of Large Proportions!

For the final project, each student will be given a candy-bar wrapper. You are to create a scaled version of your wrapper on butcher-block paper. In addition, you will also need to create a rough draft with measurements of the original wrapper. The scaled version will need to fill the butcher-block paper horizontally. Include a scale somewhere on your final paper. You should use as much detail and accuracy as possible within today's block.

You will be assessed using the following Checkbric:

You Check….	I Check…
Measurements: ____ Rough Draft shows all measurements ____ Measurements are accurate and labeled on rough draft ____ Angles are measured where appropriate ____ Rough Draft is turned in	**4** – All measurements are correct on both and are labeled on rough draft **3** - Most measurements are correct and labeled on the rough draft **2** - There are several significant errors in measurement and/or are not labeled on rough draft **1** - Many significant errors in measurement and/or rough draft is not included
Accuracy: ____ Calculations are accurate ____ Length measurements on constructed drawing are correct ____ Angle measurements on constructed drawing are correct ____ Spaces in between are also accurate ____ Scaled version fills butcher block paper horizontally	**4** - Calculations are correct and drawing measurements are accurate **3** – Most calculations are correct and most drawing measurements are accurate **2** – Calculations of scale are incorrect and/or there are several significant errors in drawing measurements **1** – Calculations of scale are incorrect and/or there are many significant errors in drawing measurements
Neatness: ____ Scale is included on enlarged drawing ____ Guidelines may be visible (but should be lighter) ____ Drawing is neat and clean ____ Final drawing is turned in	**4** – Scale is included - drawing is neat and clean **3** – Scale is included – drawing is relatively neat and clean **2** – Scale is included – drawing is not clean and/or is difficult to measure due to lack of neatness **1** – Scale is not included and drawing is not clean and/or is difficult to measure due to lack of neatness

Geometry Scaling Activity

Content Standard: Spatial sense, geometry, and measurement **Level:** Partial

Specific Statement(s) from the Standard:

Grades 9 through 11 Standards:

Subpart 1. ***Mathematical reasoning***

The student will apply skills of mathematical representation, communication, and reasoning for the standards under subparts 2 to 5.

Subpart 2. ***Number sense, computation, and operations***

A. Number sense. The student will use real numbers, represented in a variety of ways, to quantify information and to solve real-world and mathematical problems.

B. Computation and operation. The student will appropriately use calculators and other technologies to solve algebraic, geometric, probabilistic, and statistical problems.

Subpart 5. ***Spatial sense, geometry, and measurement***

A. Spatial sense. The student will use models to represent and understand two- and three-dimensional shapes and how various motions affect them. The student will recognize the relationship between different representations of the same shape.

C. Measurement. The student will use the interconnectedness of geometry, algebra, and measurement to explore real-world and mathematical problems.

Product(s):

The student will demonstrate knowledge of proportions, scaling, and ability to work with measurement tools.

Task Description:

Students will create a scaled version of a candy bar wrapper. They will use proportions and scaling to create the model. They will also need to accurately use measuring tools; yardsticks (or meter sticks), rulers, and possibly compasses. They will be scored on their ability to create a product that is accurately scaled with correct measurements.

Special Notes:

The following lessons take place in the block schedule. If these were used in a classroom with a traditional schedule, the time needed to complete each day's activities would double. These lessons are also designed for an "Informal Geometry" class. This class is traditionally less rigorous and was designed for those students that have struggled in math. It may also be appropriate for middle school age students. These lessons will utilize the "Prepare", "First Dare", "Repair" and "Share" strategy. This strategy requires the teacher to work with the students prior to instruction to talk about what they already know (prepare), ask students to try out their theories or ideas (first dare), come back as a class to talk about what they discovered, where they went wrong, etc. (repair) and, finally, have them try out what they now know and share it with you or the class (share).

The final project (Wrapping it all Up) and the final activity (Our Room Really Measures Up!) could be switched at the end of the unit. Note that the room activity would require students to work in pairs.