Oreo's Playpen

by

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Abstract: This article follows a geometry lesson in which 4th graders try to discover which shape will create the largest cage for their class pet. Area, perimeter, angles, and geometric shapes are explored as students come up with various ways to solve the problem. Literature and writing are incorporated into this real-world application of mathematics. Tables are included for the recreation of the lesson, as well as a Quick Time movie presenting the lesson from the student's perspective.

"Math is more fun when it's real," said DJ, a fourth grader with intellect beyond his years and an impressive memory. Learning new algorithms and solving mundane problems came easily to him and thus were not very enticing. Projects that reflected his real life, now those were the lessons that motivated him and other students in my 4th grade math class.

I am constantly on the lookout for the teachable moment, the lesson that creates itself or the question that sparks weeks of discovery. Such was the case when we were routinely setting up our playpen for our class pet, Oreo the hamster. Made of 8 connected wire panels, the playpen could be assembled into various shapes and sizes so that Oreo could see and be seen by the class. Two students, assigned as animal keepers for the week, began to debate over how to form the playpen. They both wanted the same goal: to give Oreo a large amount of room to run around in. Of course, my thoughts immediately ran to area, geometry, shapes, angles, and the like. This was the inspiration for the Oreo's Playpen Lesson, a two to three week discovery in geometry and area, with extensions in statistics, graphing, writing, and literature.

These activities that authentically use mathematics to solve real world problems, ask students to apply reasoning to justify their work, and analyze and make connections between a variety of representations of their work are strongly aligned with NCTM's Curriculum Focal Points [1] for grade 4 mathematics. This project would also fit nicely into the Louisiana Comprehensive Curriculum's Unit 6 for grade 4 mathematics [2].

Students Getting Started with a Cage Configuration

We started the discussion by making various shapes with the playpen. The class quickly came to an agreement about which shapes were just too crazy for Oreo to play in and formed the first rule; all angles must be large enough for Oreo to reach. (Oreo was a well-fed hamster.) This led into a discussion and exploration of how to measure angles using protractors and how to label them. We chose 20 degrees as the minimum angle size.

The students also quickly realized that categorizing and being able to talk about the shapes was going to make the project easier to understand and explain. This was a great doorway for teaching more about shape names, the common features of

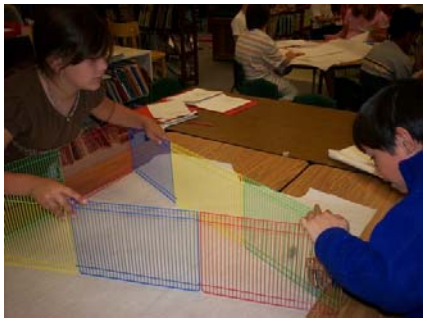
quadrilaterals, and types of triangles. Suddenly, elements of our study that might have been delegated to mere memorization became vitally important to my students, and they were interested. After all, Oreo's happiness (and possibly his blood pressure) depended on their ability to make the largest shape.

After many side lessons on shapes names, angle measurements, and shape features (regular, irregular, convex, concave), we moved on to area and perimeter. We decided to use square centimeters to measure the area and came up with a list of shapes to be explored by each small group. Within the list, there was much room for personal design and creativity. Although I was well aware that the perimeter of the playpen would never change, I asked the students to calculate this as well as the area for each shape. After several attempts, the students were quite surprised to find that the perimeter remained constant while the area changed.

A Non-Convex Polygonal Cage

Finding the area proved to be challenging. The students knew the formula for the area of a rectangle, so we started with that. When it was time to do a second quadrilateral, the groups took many different approaches. Some cut the shape into as many large rectangles as possible and added the area for each. This gave them yet another example of the real world importance of multiplying and adding multi-digit numbers. Some used centimeter graph paper, cutting it until it fit every spot. Others

used base ten blocks to fill in the shape. This took the most amount of time, but was obviously the clearest way for several students to understand. Knowing the various learning styles of the students, I found that most of them chose the style that made the most sense to them. Some disagreed in a group and had to compromise by using another student's style. No matter the choice, all were learning, cooperating, and communicating along the way.



Students Measuring Area Using Known Shapes

Students Measuring Area Using Base-10 Blocks

The students used various methods to figure out the area of 2 different quadrilaterals, a triangle, and a polygon with 5 or more sides. They could also choose to do a concave shape as a bonus. The regular octagon did have the largest area, and most groups came to this conclusion. In journaling about the project, many students decided

that other shapes were more interesting for Oreo and had areas that were close to the regular octagon.

The students monitored their progress and organized the information in several ways. They kept a learning log throughout the project and spent 15-30 minutes each week journaling on the experience. Prompts were offered, but they could choose anything to write about for that week. (See Table 1 below for journal prompts). They also used a table to organize the data collected on area and perimeter, as well as a sketch and name for the shape (see Table 3 below). These pieces would be important for the final compilation of their work into a small portfolio. I used a rubric to evaluate the work; it is included in Table 2 below.

Embedding student work in an authentic activity like creating the hamster cage provides for a reflective exploration of space in a way that is familiar to students. The task provides a springboard to geometry as described in [3] helping students to organize the way that they understand the world around them.

The cumulating moment of the project was to be when the students explained their work to the school at morning meeting accompanied by, of course, Oreo in his very large playpen. Unfortunately, our lovely little nocturnal creature managed to escape one night. At the suggestion of another teacher, we read "I, Houdini" as a class book [4], which is about a very similar escaping hamster. Although Oreo was spotted once and his remnants of seed casings and chewed crayons found often, we have stopped trying to catch the little guy. Our hope is that he made it to the "Outdoors" that Houdini in the book seemed to love so much.

The hamster playpen is great for a variety of pets and can be purchased at local superstores or pet stores for less than fifteen dollars. Without a class pet, this project obviously has less personal significance to the students. The topics covered, however, can be easily used in different situations. The students can also create their own version of fencing by cutting out rectangles (1 by 8 inches) and connecting them in the last inch with a metal brad. Using the homemade manipulatives of any number of sides, the same thought processes can be applied to a garden or playground fence. The use of scale can also be incorporated into projects such as these. For example, if one inch represents one foot, what is the largest garden area you can create using 12 panels of 4 feet each? Does the shape affect the beauty or usefulness of the garden? After researching certain plants and how far apart they need to be planted, what shape allows for the most plants?

The first time I did this with the students, I had no set goals for it but just wanted them to explore geometry in a real way. Now that I've followed two years of students along this project, I am amazed by the amount of topics one project can cover. Definitions like regular, concave, parallel, angle became very real to my students, and there was an important reason to know them. The problem solving explorations were incredible, as some discovered formulas for the area of a trapezoid using triangles and rectangles, and others found shortcuts for counting the base ten blocks in a shape. Communication became vital, between group members and by evaluating one's own thoughts about the learning process in a journal. In the end, I learned as much as they did, and we all had a love for geometry that went far beyond the walls of our hamster's playpen.

Click Here for QuickTime Movie done by Class:

http://www.promotinglearning.com/LATM/oreo2.mov

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REFERENCES

[1] Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics: A Quest for Coherence, National Council of Teachers of Mathematics, 2006, ISBN: 0-87353-595-2

[2] Louisiana Comprehensive Curriculum Grade 4 Mathematics, Unit 6 http://www.doe.state.la.us/lde/uploads/6915.pdf

[3] *Springboards to Geometry* by R. Lehrer and T. Romberg, pp. 62-70 in Perspectives for Teaching Geometry in the 21st Century: An ICMI Study, Carmelo Mammana and Vinicio Villani editors, Kluwer Academic Publishers, ISBN: 0-79234-990-3

[4] I, Houdini: The Autobiography of a Self-Educated Hamster, by Lynne Reid Banks, Dell Yearling, ISBN: 0-44041-924-7

TABLE 1 -- Journal Prompts

- Pretend you are Oreo. Write what you like dislike about this particular shape. What observations do you have about this shape?
- What was the easiest or most difficult moment from the project this week?
- What shape do you think will have the greatest area? Have you changed your mind about this answer since we started the project?
- In what ways does the playpen limit what shapes you can create?
- What methods did you use to calculate the area this week? Are they different from previous weeks?
- What methods of calculating area are easier to use? Why?
- What methods of calculating area do you like the best? Why?
- What method of calculating area do you think is most accurate? Why?

TABLE 2: Project Rubric

POINTS	0	3	5
Cover and Table	No Cover or table	Cover page or table included, but missing information	Cover page with name, date, title, and illustration and Table filled out correctly
Journal	No journals included	1-3 journals included, with little explanation or many proofreading errors	1-3 journal included that explain thoughts from the project and are proofread for spelling, punctuation, and grammar errors.
Triangle	No triangle included	Triangle not drawn or labeled correctly	Triangle drawn and labeled correctly
Polygon (more than 4 sides)	No polygon included	Polygon not drawn or labeled correctly	polygon drawn and labeled correctly
Quadrilateral 1	No quadrilateral included	Quadrilateral not drawn or labeled correctly	Quadrilateral drawn and labeled correctly
Quadrilateral 2	No quadrilateral included	Quadrilateral not drawn or labeled correctly	Quadrilateral drawn and labeled correctly
Area: Triangles	No area listed	Area not accurate, no method explained	Area is accurate and written correctly
Area: Quadrilaterals	No area listed	Area not accurate, no method explained	Area was properly calculated using formulas
Area: Polygon	No area listed	Area not accurate, no method explained	Area is accurate and written correctly
Conclusion Journal	No conclusion journal	Conclusion included	Conclusion compares the area of the shapes, the methods used to figure the area, and a final recommendation of shape for the playpen.

Name_____Date_____

TABLE 3: Project Data Collection Sheet
TOTAL POINTS_____/50
Title:_____

Group Names_____

Sketch of Shape	Name of shape	Perimeter (in centimeters)	Area (in square cm)