Circles, Circles, Area

Summary

This activity helps students explore the area of a circle.

Materials

- [A Circles Square](#) (pdf)
  cm graph paper
  circular objects
- [A Circles Area](#) (pdf)
- [Going in Circles](#) (pdf)

Background for Teachers

This activity helps students explore the formula for the area of a circle, (r^2 x pi). By working with circles, students will develop an understanding of the relationships among the area of a circle, the radius, and pi. Before beginning this activity, students should understand the meaning of the diameter and radius of a circle.

Instructional Procedures

Invitation to Learn

Pose this problem to your students:

A pizzeria decides to sell three sizes of its new pizza. A small pizza is 10 inches in diameter, a medium pizza is 14 inches in diameter, and a large is 18 inches in diameter. The owner of the pizzeria decides that the price of the small pizza will be $5.00, the medium pizza will be $8.00, and the large pizza will be $12.00. Do you think a large pizza is always the best deal? How would you estimate which pizza size is the best value?

Have the students brainstorm ideas for figuring out which pizza is the best value. Do not lead them in any direction, just listen to their ideas. You will come back to this problem at the end of the Day Two activity.

Instructional Procedures

Day One

Ask students how they find the area of triangles and parallelograms. Remind them that they came up with the formula for the area of triangles and rectangles by comparing them to rectangles. For triangles they multiply base x height and then divide it by 2, because a triangle is 1/2 the area of a rectangle. For parallelograms, they can cut it up to make it a rectangle, so base x height is also the formula for area. Explain to them that by using squares, they can learn more about the area of circles.

Pass out the worksheet, *A Circles Square.*

Explain to the students what a radius square represents.

Have students figure out how many radius squares it takes to cover one of the circles. Have them cut out radius squares so they can see how many radius squares it takes to cover that circle.

After completing the worksheet, have students write their findings in their math journals. What did they find out about the radius squares? How many radius squares did it take to cover the area of the circle? Did it take the same number of radius squares for all three of the circles?

Have a class discussion about what they learned from this activity. Listen to the students comments and ask questions to deepen their thinking. Do not explain how to find the area of a circle, this will happen in the next part of the activity.

Day Two

Hand out centimeter graph paper to groups of students.

Have students find two circular objects and trace them on graph paper. Encourage students to center the objects at an intersection of grid lines so that the pair of perpendicular grid lines will divide the traced figures into four equal quadrants. This position will make it easier for students to count the number of square units in the area of each circle. (You may want to show how to line up a circular object on overhead graph paper.)

Pass out *A Circles Area*, and have them work with their groups to find the radius and area for two circular objects. Encourage students to be as accurate as possible as they count squares to determine the area of the circles.

Have the groups share their data from one of their circular objects with the class to complete their charts for radius and area.

Point out that the chart is designed to help them explore a formula for the area of a circle. Have them look at the column that asks them for r^2. Explain that area is a two-dimensional measurement in square units. Remind them that they need two linear dimensions -- base x height -- for their previous calculation of area (for a rectangle, parallelogram, triangle, and square). The area of a circle is also a two-dimensional measurement, but instead of using base x height, they use radius x radius, or r^2.

Have students complete the column for radius squared.

Bring the class together again and have them look at the A/r^2 column. Explain to the students that for this column, the area is divided by radius squared.

Have students complete the column for A/r^2. The results should be around 3.14, or pi. However, because of inaccuracies in measurement of radius and area, the values may very significantly. Taking an average of all the values in the column might help generate a value close to pi.

Have a group report their results for the A/r^2 column. Ask students why they think the data varied for each circular object. Have the students come up with a class average for the column.

Have a class discussion on the relationships among the radius, area, and pi. Have students complete their worksheet by writing a formula for the area of a circle. Talk about the formula they created.

Have students write the formula in their math journals. Also have them explain what they learned about the area of a circle from doing Day One and Day Two of this activity.

Go back to the pizza problem you posed in the Invitation to Learn. Have students figure out which pizza size would be the best deal. Talk about the results and how they figured out which size was the best deal. Have them write their results in their math journals.

Have them complete the assessment, *Going in Circles*.

Extensions

Have your class go to the gym or playground (anywhere where there is a large circle painted on the ground). Have the students line up around the circle. Have them pair up with a student opposite them (across an imaginary diameter line). Have student A run the diameter of the circle, and student B run the circumference. Have them run until they end up at the same place (or close to it). Student A will have to run the diameter three times while student B makes one revolution. Have each pair of students race, and then talk about pi and the ratio between the circumference and diameter of a circle.

Family Connections

The next time their family wants to order a pizza, have students find out which pizza place has the best deal for a large pizza. Have them turn in their findings for extra credit (or something like it).

Assessment Plan

Informal assessment includes class discussion, math journals and observation of group work.

- *A Circles Square*
- *A Circles Area*
- *Going in Circles*

Bibliography

Hinzman, K.P. (1997). Use of Manipulatives in Mathematics at the Middle School Level and Their Effects on Students' Grades and Attitudes. ERIC Source (ERIC # ED411150). Retrieved December 10, 2006, from http://www.eric.ed.gov
This paper reports on a study that examines mathematical scores when hands on manipulatives and group activities were used in the classroom. Results indicate that student performance was enhanced by the use of manipulative materials; and students' attitudes toward mathematics were significantly more positive than those in previous years when manipulatives were not used.
Reid, J. (1992). The Effects of Cooperative Learning with Intergroup Competition on the Math Achievement of Seventh Grade Students. ERIC Source (ERIC # ED355106). Retrieved November 28, 2006, from http://www.eric.ed.gov
This paper reports a study designed to determine the effect of cooperative learning strategies on mathematics achievement of 7th graders. Students were divided into two groups. One group participated in cooperative learning strategies, and the other group received individual/competitive instruction. Pre-tests indicated that no differences existed in the groups prior to instruction, but that the cooperative learning groups performed significantly higher on the post--test. The paper concluded that cooperative group learning strategies are more effective in promoting mathematics achievement.

Authors

Karen Krier