Bullseye

Your Challenge

How are the circumference and area of a circle related to its radius?

➤ **Use graphing technology to investigate the relationship between the radius, circumference, and area of a circle.***

  a. Open the graphing technology program.

  b. Type (0, 0) in the field to enter a center point for the circles.

  c. Use the *Circle* tool to draw circles with their center at the origin and with radii of 1, 2, 3, 4, and 5 units.

    1 Do the circumferences of the consecutive circles appear to be in a proportional relationship? Explain.
    Answers will vary.

    2 Do the areas of the consecutive circles appear to be in a proportional relationship? Explain.
    Answers will vary.

  d. Investigate the relationship between circumference and radius. Use the *Length* tool to find the circumference of each circle to the nearest tenth. Then open a new graphing window and plot five points using the format (radius, circumference) where the radius is the *x*-coordinate and the circumference is the *y*-coordinate. Connect the points.

    3 What does the graph of the connected points look like?
    When the points are connected, they form a line.

    4 Can you tell from the graph if the relationship between the circumference and the radius of a circle is a proportional relationship? Why or why not?
    Yes; Possible explanation: The points form a line that goes through the origin. This shows that the relationship is proportional.

* You may need to adjust the steps depending on which geometry software program you use. If needed, use Help or Support menus or online tutorials.

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e. Investigate the relationship between area and radius. Use the *Area* tool to find the area of each circle to the nearest tenth. Then open a new graphing window and plot five points using the format (radius, area) where the radius is the *x*-coordinate and the area is the *y*-coordinate. You may want to adjust the intervals on the axes in the Settings menu so the *x*-axis extends from 0 to 10 and the *y*-axis includes the maximum area. Connect the points.

5 What does the graph of the connected points look like?

When the points are connected, they form a curve. They are not in a straight line.

6 Can you tell from the graph if the relationship between the area and the radius of a circle is a proportional relationship? Why or why not?

Yes, I can tell that the relationship is not proportional. Possible explanation: The points do not lie in a straight line. This shows the relationship is not proportional.

f. Look back at your answers to problems 1 and 2.

7 As the length of the radius of a circle increases, does the circumference increase proportionally? Does the area of the circle increase proportionally? Do your answers match your initial guesses in problems 1 and 2?

The circumference does increase proportionally, but the area does not. Possible answer: I thought the circumference didn't increase proportionally, and I thought the area did increase proportionally, but I was incorrect. The reality is the opposite of my guess.

8 Generalize what you have seen about the relationship between the radius and the circumference and the radius and the area. If the radius of a circle is doubled, what do you notice about the circumference? What do you notice about the area?

Possible answer: If the radius of a circle is doubled, the circumference is also doubled, and the area is multiplied by 4.

Build a Chicken Run

Your Challenge

Emma wants to build a run for her chickens. A *run* is an enclosure that gives chickens access to outdoor space. She wants the enclosure to be a composite figure, made of a rectangle and another figure, that has a total area of 100 square meters and uses as little fencing as possible.

➤ **Use graphing technology to design a composite figure with an area of 100 square meters.***

   a. Open the graphing technology program.

   b. Use the *Polygon* tool to draw a composite figure in the grid space. The composite figure must be composed of two shapes, at least one of which must be a rectangle. This composite figure models the enclosure.

   c. Use the *Area* tool to calculate the area of the composite figure.

   d. Adjust the composite figure, or draw a new one, so that you have a figure that has an area of 100 square units.

   e. Use the *Distance* or *Length* tool to calculate the length of the sides of the figure. Find the perimeter.

      1 Describe your composite figure or sketch a drawing of it. How much fencing would be needed to build an enclosure shaped like this?

      Possible answer: The figure is two rectangles attached together to form an L-shape. The rectangles are identical in size. Each has a width of 5 meters and a length of 10 meters. The length of one rectangle shares 5 meters of its side with the width of the other rectangle. The perimeter of the composite figure is 50 meters.

   f. You may want to take a screenshot of the composite figure that includes the area of the figure and the lengths of the sides. Copy the screenshot into a blank document to keep track of the composite figures you draw.

* You may need to adjust the steps depending on which graphing program you use. If needed, use Help or Support menus or online tutorials.

Build a Chicken Run

g. Analyze the composite figure. Think about ways you can change the composite figure so that the area of the figure remains 100 square meters but the perimeter decreases.

h. Use the *Polygon*, *Area*, and *Distance* tools to make and record other composite figures. Try to decrease the perimeter of the enclosure while keeping the area the same. Stop when you think you have drawn an enclosure that will use the least amount of fencing possible.

2 Describe the ways you changed your composite figure to make the perimeter smaller.

Possible answer: I made the line that the two rectangles shared longer because that area is inside the enclosure where no fence is needed. I also tried making composite figures from rectangles and triangles to see if a triangle would decrease the perimeter.

3 Describe and sketch the enclosure you believe has the smallest perimeter with an area of 100 square meters. Explain why you chose this composite figure.

Possible answer: I wanted the figures that make up the composite figure to share as much border as possible. I chose a rectangle and a triangle because the triangle has only two sides that aren't touching the rectangle. Another rectangle or square would have three sides that don't touch the rectangle, leading to a longer perimeter. The perimeter of my composite figure is approximately 39 meters.