Fencing In Spaces: Constant Perimeter, Changing Area

Lesson Plan Overview

Essential Question: For a fixed perimeter, what are the shape and area of the rectangles with the greatest and least area?

Learning Goals:

- Students will be able to create different rectangles using a fixed perimeter.
- Students will be able to find the area of their different rectangles.
- Students will use strategies to compare area and perimeter.
- Students will make conclusions to determine the largest possible area for a rectangle having a fixed perimeter and whole-number dimensions.

Standards: Grade 6: *Solve real-world and mathematical problems involving area, surface area, and volume.* CCSS.MATH.CONTENT.6.G.A.1 - Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

Curriculum Alignment: Adapted from CMP3 Covering and Surrounding Lesson 1.3

Pre-Planning

- **Total Time:** 75-90 minutes
- **Prior Knowledge & Vocabulary:** Define Rectangles and their Properties; Rules for Perimeter; Rules for Area; Define "Fixed"; Define Dimensions, *Length and Width*
- **Materials:**
  - Lesson 1.3 Student Activity Sheet
  - PhET "Area Builder" Simulation (https://phet.colorado.edu/en/simulation/area-builder)
  - Photos of Various Dog Pens
  - Chart Paper to Record Student Ideas and Sketches

Area Builder Simulation Activity

Warm Up **8-10 minutes**

Begin by launching the problem with pictures of various dog pens. Discuss the materials needed to build a dog pen, and which of the materials represent area and which represent perimeter. Focusing on the length of fence to represent perimeter, tell the students they have a given amount of fencing and need to design a dog pen that will give your dog the most amount of area. The pen must be rectangular; also, remind students that a square is also a rectangle. (Idea: Using a piece of string or a string of paper clips that has a fixed length, have students think privately first and then with partners about different rectangles they could create using the string/paper clips to simulate a 'fixed fence'. Share out all combinations.

Simulation Introduction	10-15 minutes

Teacher Guided: Search "PhET Area Builder." Click Explore. Click both options (grid shown, dimensions shown) in bottom left hand of screen. On the bottom right of the screen, will see a slider on the bottom right. Slide the slider to the right to get two screens. This way you can either have an option of a larger grid or two grids to compare rectangles. Pass out the activity sheet and have students complete part one (fixed perimeter of 12m) before launching the lesson.

Guided Exploration	15-20 minutes

Teacher Guided: Tell students they only have 24 meters of fencing and have to create as many different rectangles as they can with the given perimeter. No fencing can be wasted and they can only use whole number dimensions. (Could have students practice with a given perimeter of 12m first before they go into the sim and use a perimeter of 24m).

Students: Let students explore individually for about 2-3 minutes, then bring everyone back together and have a student (perhaps someone who made a 1m x 11m) come up and show how they created it. After they share, students can work in partners to try to find all combinations of rectangles with a perimeter of 24m. Walk around and ask students probing questions about what they notice or why certain rectangles work and others don't.

Possible Discussion Questions:
- Do you notice a pattern in the rectangles you are creating?
- How is the shape of the rectangles changing while keeping the same amount of fencing?
- Will a 4m by 6m rectangle work? How do you know? Why or why not?
- Which type of rectangle will give your dog the most amount of area? How do you know? Why is that true?

Summary	10-15 minutes

Begin the summary by bringing the students back together and asking what they noticed about the different dog pen configurations they recorded on their activity sheet.

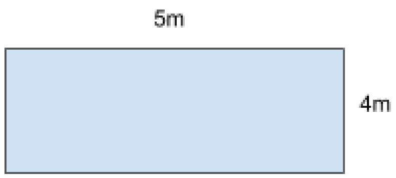
Ask why certain rectangles have the greatest or the least area. Encourage them to look across the data for patterns in the shape of the rectangles and consider how area and perimeter are related as they change.
-Given a fixed amount of fencing (perimeter), what kind of rectangle results in the LEAST area?
-Given a fixed amount of fencing (perimeter), what kind of rectangle results in the GREATEST area?
-Why is this true?

Some students may talk in terms of numbers or dimensions and others will describe the shape. Encourage both.

Formative Assessment	8-10 minutes

Exit Slip

Peter wants to build a small bunny pen. He has only enough fencing for a total perimeter of 20 meters. He decides he wants to build a rectangle like the one shown below.



1) Will Peter's design work? Justify how you know.

2) Draw a bunny pen that would give the greatest area with a fixed perimeter of 20m. How can you convince Peter that it works?