Exploring the Relationship Between Area and Perimeter

Strand: Measurement and Geometry

Topic: Exploring Relationships Between Area and Perimeter

Primary SOL: **4.MG.3 The student will use multiple representations to develop and use formulas to solve problems, including those in context, involving area and perimeter limited to rectangles and squares (in both U.S. Customary and metric units).**

        e)   Identify and represent rectangles with the same perimeter and different areas or with the same area and different perimeters.

Materials

- Building Rectangles recording sheet (attached)
- Manipulative materials (to include, but not limited to color tiles, graph paper, colored pencils/crayons)
- Graph Paper (attached)
- Building a Backyard Fence activity sheet (attached)

Vocabulary

addends, area, area model, array, diagram, factor, formula, length, measure, measurement, perimeter, polygon, product, rectangle, sides, square, sum, unit, width

Student/Teacher Actions: What should students be doing? What should teachers be doing?

Part 1: Same Area and Different Perimeters

Note: Prior to the lesson, set up a station or table with materials that can be used by students for problem solving.

1. Arrange students in pairs. Give each pair 12 color tiles. Ask students to build a rectangle that uses all 12 tiles. Then have them find as many other ways as possible to use the 12 tiles to create a rectangle. As a class, discuss the various rectangles created and highlight that the tiles represent area, so the area of each of rectangle is 12 color tiles (or 12 square units).

   a. Each pair can choose one of the ways that they created a rectangle and determine the perimeter of the rectangle. Then, as a class, share the perimeter of each rectangle and facilitate a discussion about the various perimeters that they found. Ask students, "*What do you notice? What do you wonder? Why do you think the perimeter of this rectangle is different than the perimeter of that rectangle?*"

2. Have students build the different rectangles on the Building Rectangles recording sheet using color tiles. Then have students shade in the different rectangles they made on their recording sheet. Once students have shaded in to show the different rectangles, have them find the perimeter of each rectangle. Ask students, "*What do you notice? Are the perimeters the same? Are they different?*"

Part 2: Same Perimeter and Different Areas

1. Give students a piece of graph paper or use the printable graph paper below. Have students work in pairs and build a rectangle that has a perimeter of 16 units. (Allow students to use square tiles first, if needed.) As a class, discuss the various rectangles created and highlight that the distance around each rectangle is 16 units.
   a. Each pair can choose one of the ways that they created a rectangle and determine the area of the rectangle. Then, as a class, share the area of each rectangle and facilitate a discussion about the various areas that students found. Ask students, "*What do you notice? What do you wonder? Why do you think that the rectangles have different areas? If you wanted to create the rectangle with a perimeter of 16 and the greatest area, what would the rectangle look like? Did you notice any patterns in the relationship between the perimeter and the area?*"
2. Have students complete the activity sheet, Building a Backyard Fence. Your family has adopted a dog. You want to build a fence in your backyard, so your dog has room to run and play. You can only afford 20 feet of fencing to build a rectangular shaped pen for your dog.
   a. If you want your dog to have as much room as possible, what would be the length of each of the sides of your rectangle?
   b. How would the sides change if you had 25 feet of fencing?

Assessment

- **Questions**
  - How does using a rectangular open area model for multiplication help to efficiently determine the area of a rectangular shape?
  - Your grandfather is building a picture frame as a birthday present. He knows the area of the printed picture is 25 sq. inches. He knows the picture is in the shape of a square. What would the sides of the picture frame he makes need to be?
  - Michelle designs a rectangular pen that uses 36 feet of fencing. Her rectangle is 12 feet on one side and 3 feet on another side. She says that her rectangle has the largest possible area using 36 feet of fencing. Marcus says that he can use 36 feet of fencing to build a rectangle with a larger area. *Who is correct? How do you know that they are correct?*

- **Journal/writing prompts**
  - Describe a situation in which two similar items could have the same perimeter, but different areas. Describe a situation in which two similar items could have the same area, but different perimeters.
  - Your family is moving to a new house. Your mom wants to take the rug that is in your living room and move it to the living room of the new house. She says that she knows it will fit because both living rooms have the same perimeter. Will the rug definitely fit in your new house? Why or why not? Is there a situation where it won't fit?

- **Other Assessments**
  - Monitor students closely as they work on the problem to discover and correct misconceptions regarding the measurements of perimeter and area.
  - Analyze student recording sheets for clear and accurate communication of mathematical language associated with perimeter and area.
  - Ask students to talk with several adults and ask them when they use area and perimeter measurements in their work or home life and make of list about what they learn.

Extensions and Connections (for all students)

- Use tiles to construct several different multiplication arrays that have a total area of 48 square units. What is the perimeter of each array? Which array has the greatest perimeter?
- You are getting a new chicken, and you want to build a rectangular pen. You have 18 feet of fencing. What are the possible dimensions of the pen? Which dimensions would you recommend? Why?
- A teacher has two rugs in their classroom. Rug A has a perimeter that is smaller than Rug B, but an area that is greater than Rug B. How is that possible? Give examples of rug measurements that might explain how it is possible.

Strategies for Differentiation

- Encourage students to use tiles or centimeter cubes during the activity as needed.
- Encourage students to act out the scenario and to draw out the scenario for enhanced engagement and entry points for problem solving.
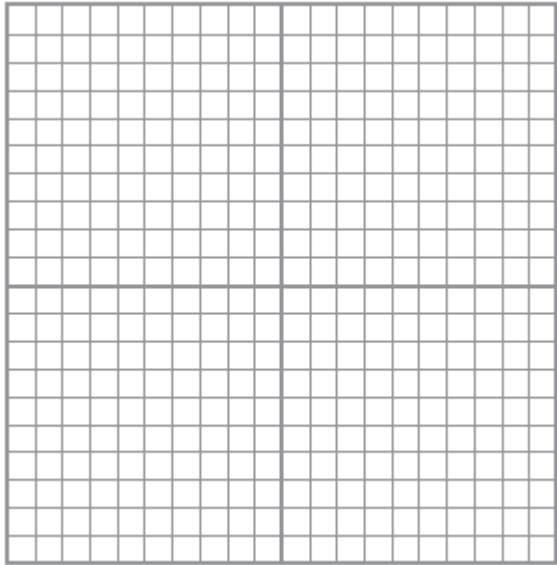
Note: The following pages are intended for classroom use for students as a visual aid to learning.

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Building Rectangles Activity Sheet

Directions: Build as many rectangles as you can with each area and record each perimeter.
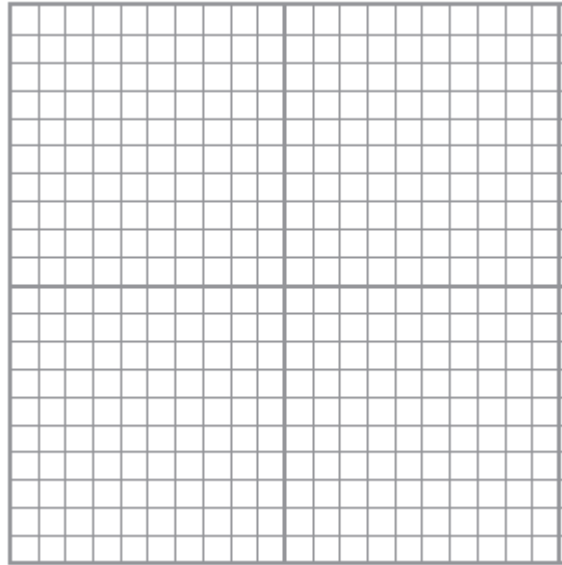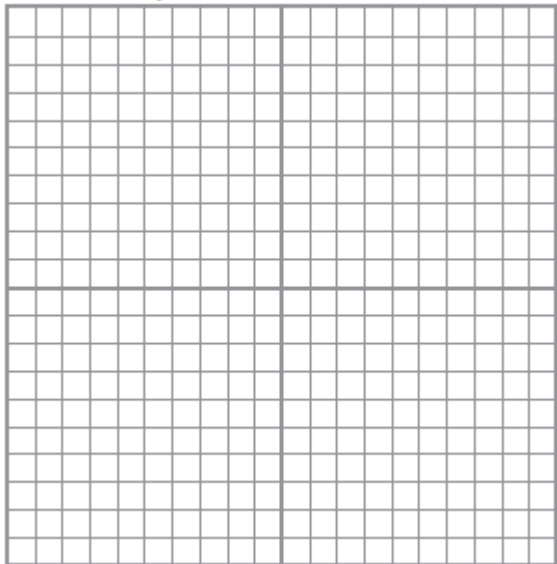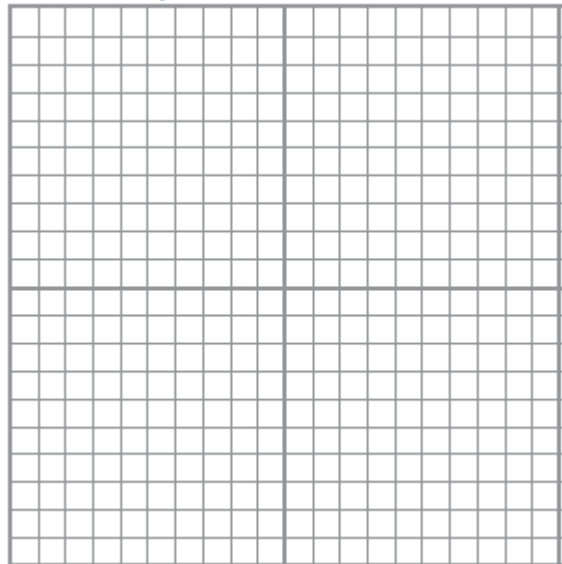
Area= 20 sq. units	**Area= 18 sq. units**

Perimeter= _____

Perimeter= _____

Perimeter= _____

Perimeter= _____

Perimeter= _____

Perimeter= _____
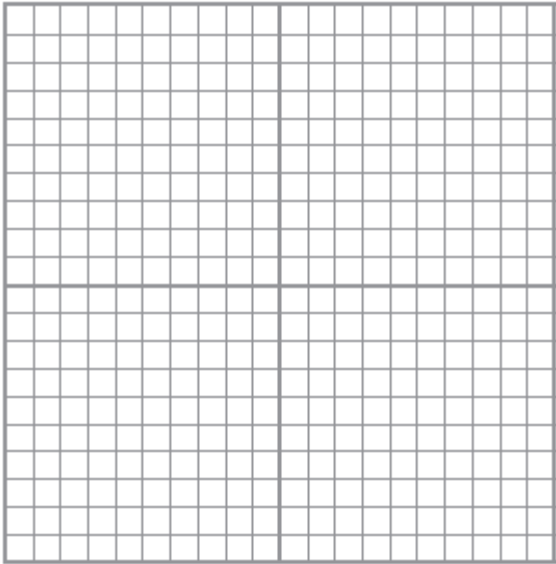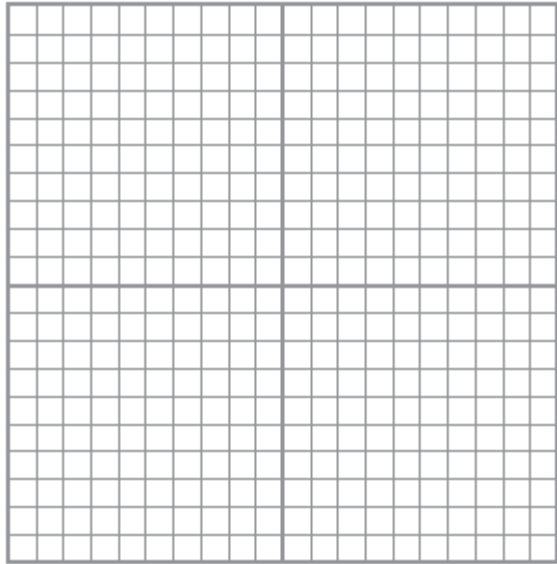
Area= 24 sq. units	**Area= 30 sq. units**

Perimeter= _____

Perimeter= _____

Perimeter= _____

Perimeter= _____

Perimeter= _____

Perimeter= _____

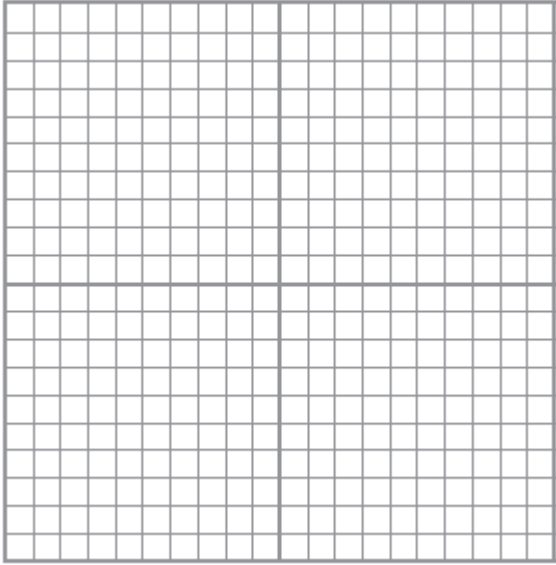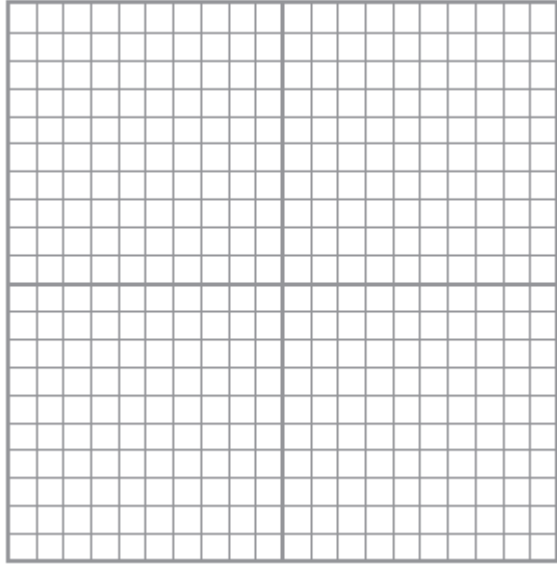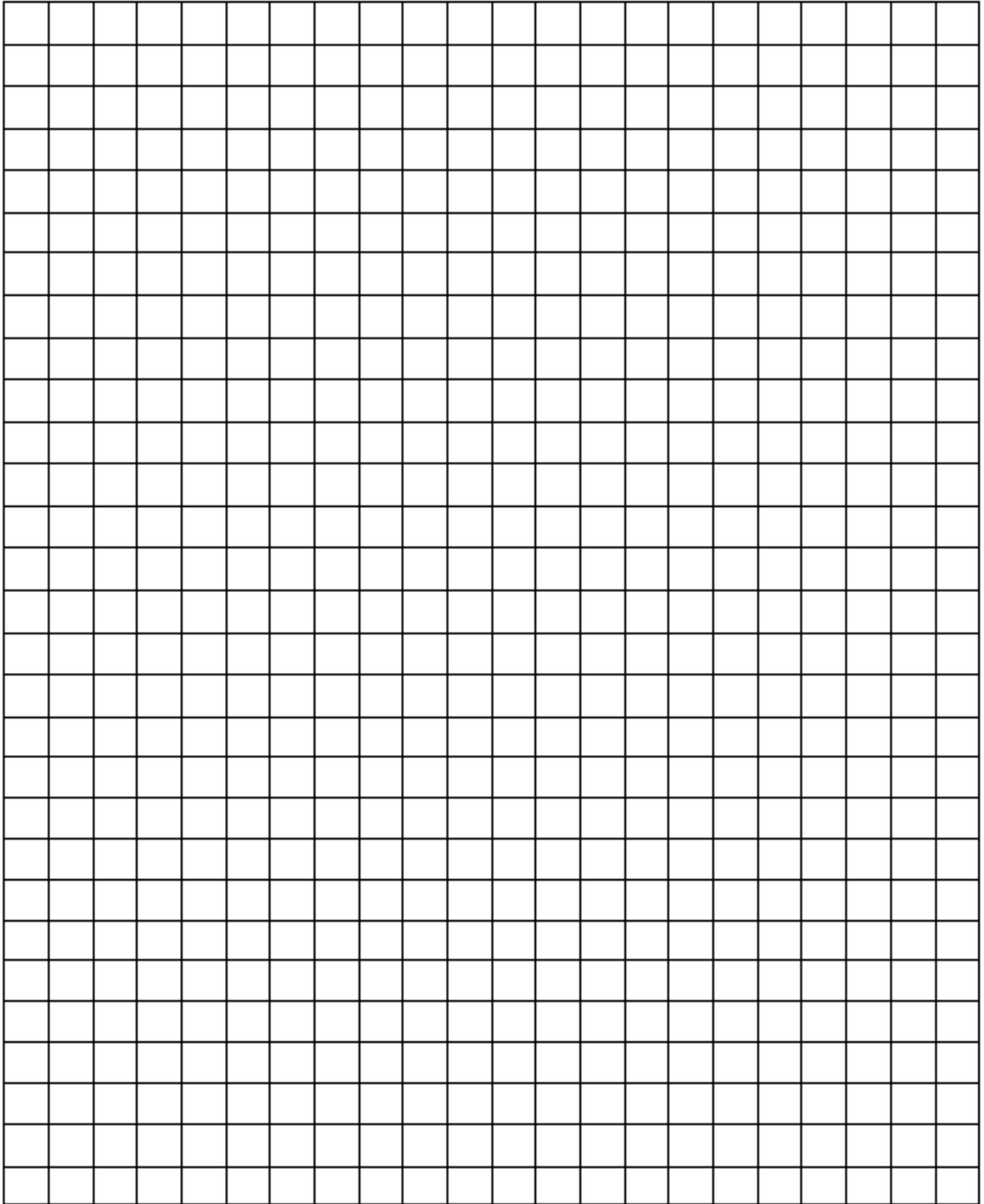**Area= 16 sq. units**

Perimeter= _____

Perimeter= _____

Perimeter= _____

Area= 36 sq. units

Perimeter= _____

Perimeter= _____

Perimeter= _____

Area= 15 sq. units

Perimeter= _____

Perimeter= _____

Perimeter= _____

Area= 9 sq. units

Perimeter= _____

Perimeter= _____

Perimeter= _____

Grid Paper

Building a Backyard Fence

Your family has adopted a dog. You want to build a fence in your backyard, so your dog has room to run and play. You can only afford 20 feet of fencing to build a rectangular shaped pen for your dog. What can be the dimensions of the pen? Show your work and justify your solution.