The Garden Problem
Created by:
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Spring 2016

The Task
The garden club is designing a rectangular butterfly garden for their school yard. The garden will be fenced to protect the flowers from being stepped on by children playing.
1. What might be the length of the garden fence if the area of the garden is 12 square yards?
2. If the members of the garden club want to spend the least amount of money possible on fencing, what length of fencing should they purchase for a garden area of 20 square yards?
3. How would you go about determining the shortest fencing length for any rectangular garden area?

Solve using pictures, words, tables, graphs, and/or symbols.

Big Ideas
Measurement/Geometry: For a given perimeter there can be a shape with area close to zero. The maximum area for a given perimeter and a given number of sides is the regular polygon with that number of sides.

Standards of Learning for Grades 3-4-5

3.10 – The student will a) measure the distance around a polygon in order to determine perimeter; and b) count the number of square units needed to cover a given surface in order to determine area.
5.8 – The student will a) find perimeter, area, and volume in standard units of measure; b) differentiate among perimeter, area, and volume and identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation.

Standards of Learning for Grades 6-7-8

7.5 – The student will a) describe volume and surface area of cylinders; b) solve practical problems involving the volume and surface area of rectangular prisms and cylinders; and c) describe how changing one measured attribute of a rectangular prism affects its volume and surface area.
8.7 - The student will a)investigate and solve practical problems involving volume and surface area of prisms, cylinders, cones, and pyramids; and b) describe how changing one measured attribute of a figure affects the volume and surface area.

Process Goals
- Problem Solving and Reasoning – Students will apply their understanding of perimeter and area, as well as use reasoning to solve the problem.
- Connections and Representations – Students will recognize and use the connections between perimeter and area to solve the problem and make generalizations. In addition, students will use a variety of representations as they solve the problem and communicate their thinking.
- Communication – Students will justify their findings and present their results to the class with precise mathematical language.

Related Task – The Rabbit Pen Problem
Ms. Brown's class will raise rabbits for their spring science fair. They have 24 feet of fencing with which to build a rectangular rabbit pen to keep the rabbits.
1. If Ms. Brown's students want their rabbits to have as much room as possible, how long would each of the sides of the pen be?
2. How long would each of the sides of the pen be if they had only 16 feet of fencing?
3. How would you go about determining the pen with the most room for any amount of fencing?

Solve using pictures, words, tables, graphs, and/or symbols.

Related Task – The Table Problem
Thanksgiving dinner for 32 guests will be hosted at your home. You plan to rent square tables that seat 4 people. Each table costs $10 to rent (chairs are free). So everyone can participate in the dinner conversation, all guests will be seated around one rectangular table.
1. Determine the least expensive way to seat all 32 guests.
2. Determine the most expensive way to seat all 32 guests without having any extra seats.
3. Compare the table arrangements. How does the shape of the table affect the rental cost?

Solve and justify using pictures, words, tables, graphs, and/or symbols.

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Lesson Plan
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Materials
- The Task
- Calculators
- Grid Paper
- Color Tiles
- Poster Paper (one sheet per group)

Facilitating Task
- Launch the task by reading it aloud.
- Clarify the task as needed by asking students to retell the story and identify what's known and unknown.
- Provide individual think time, so students can process and begin solving.
- Small groups (4 students maximum) compare strategies and solutions. After reaching consensus, small groups record solution and justification on Poster Paper.
- Each group shares their solution and justification.
- The teacher asks questions to support students in connecting the strategies shared and the mathematical ideas highlighted.

Misconceptions
- Students might confuse the definitions of area and perimeter.
- Students might mix up the methods for calculating area and perimeter.
- Students might have difficulty recognizing patterns and making generalizations, especially if possible solutions are not organized.

Suggested Prompts or Questions
- How is this problem similar to other problems you might have solved?
- How might you represent this situation?
- What tools might you use to represent this situation?
- How might you calculate area? Perimeter?
- How might you organize possible solutions?
- What are the attributes of a rectangle?

The Garden Problem

Name_____

Date_____

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Solution Strategies - The Garden Problem

①

A (yd²)	L	W	P (yd)
12	1	12	26
12	2	6	16
12	3	4	14

A - area
L - length
W - width
P - Perimeter

$A = L \times W$
$P = 2L + 2W$
or
$P = 2(L + W)$

- Completed chart by thinking of all the factors of 12.
- Recorded each factor pair, and the computed perimeter.

Answer: The length of the fence could be 26 yd, 16 yd, or 14 yd.

→ Some students might use 12 square tiles, and rearrange to make different rectangles.

→ Some students might use grid paper to draw rectangles.

②

A (yd²)	L	W	P (yd)
20	1	20	42
20	2	10	24
20	4	5	18

Answer:
They should purchase 18 yds. of fencing and design the garden to be 4 yd. by 5 yd.

③ It seems like the shorter perimeters result when the length and width are nearly the same. The shape of the garden is short and fat, rather than long and skinny. So for any rectangular garden, I would make the length and width as close to equal, as possible.