

Utah's Largest Math Event 2008-2009

The Queen's Croquet-Ground

5th/6th Grade

Standard II: Students will use patterns and relations to represent and analyze mathematical problems and number relationships using algebraic symbols.
5th Objective 1: Identify, analyze and determine a rule for predicting and extending numerical patterns involving operations whole numbers, decimals, and fractions.
6th Objective 1: Analyze algebraic expressions, tables, and graphs to determine patterns, relations, and rules.
Intended Learning Outcomes: <ol style="list-style-type: none">1. Develop a positive learning attitude toward mathematics.2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.3. Reason logically, using inductive and deductive strategies and justify conclusions.4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.5. Connect mathematical ideas within mathematics to other disciplines and to everyday experiences.6. Represent mathematical ideas in a variety of ways.

Background Information

Working with patterns is at the heart of mathematics. Exploring repeating patterns in the elementary grades lays the foundation for considering growing patterns (Van de Walle, 2000) and number sequences in the middle grades. Exploring patterns is a vehicle to provoke thinking about variables and functions. Various solution strategies and their expressions in words and with symbols naturally lead to a consideration of the equivalence of algebraic expressions. This activity is intended to promote algebraic thinking with your students.

Materials

Copies of "The Queen's Croquet-Ground #1" for each pair of students

Copies of "The Queen's Croquet-Ground #2" for each student

Graph paper

Invitation to Learn

'Get to your places!' shouted the Queen in a voice of thunder, and people began running about in all directions, tumbling up against each other; however, they got settled down in a minute or two, and the game began. Alice thought she had never seen such a curious croquet-ground in her life; it was all ridges and furrows; the balls were live hedgehogs, the mallets live flamingoes, and the soldiers had to double themselves up and to stand on their hands and feet, to make the arches.

The chief difficulty Alice found at first was in managing her flamingo: she succeeded in getting its body tucked away, comfortably enough, under her arm, with its legs hanging down, but generally, just as she had got its neck nicely straightened out, and was going to give the hedgehog a blow with its head, it would twist itself round and look up in her face, with such a puzzled expression that she could not help bursting out laughing: and when she had got its head down, and was going to begin again, it was very provoking to find that the hedgehog had unrolled itself, and was in the act of crawling away: besides all this, there was generally a ridge or furrow in the way wherever she wanted to send the hedgehog to, and, as the doubled-up soldiers were always getting up and walking off to other parts of the ground, Alice soon came to the conclusion that it was a very difficult game indeed. (*Alice's Adventures in Wonderland* Chapter 8, Lewis Carroll)

Alice was definitely having a hard time playing croquet with the Queen! What made matters worse was that the Queen kept changing the size of the croquet field!

Instructional Procedures

Activity 1

The Queen of Hearts is never satisfied. She is always changing the size of the croquet field. When Alice first starts playing croquet with her the field looks like #1. Ten minutes later the Queen changes the ground to look like #2. Ten minutes later it looks like #3, and so on. *Describe what the #5 croquet field would look like. Draw a sketch of this field.*

As a class, predict how many squares the 15th field would have and what it would look like. Also discuss how to write a rule that would give the total number of squares for any croquet field in this sequence.

Activity 2 (Qualifying Problem for ULME)

Activity 1 is a foundational activity for completing this activity.

Now the Queen has ordered the soldiers to build a fence around the perimeter of each new croquet-ground.

1. Use a pattern from the sequence of shapes to determine the perimeter of the fifth shape in the sequence. Show or explain how you arrived at your answer.
2. Write a rule that you could use to find the perimeter of any shape in the sequence. Explain how you found your rule.

Students must explain their thinking process by:

1. Producing a visual representation of the patterns (ex. organized list, table, or sketch of manipulatives used for exploration).
2. Writing a description of the reasoning and justification of the process and solution.

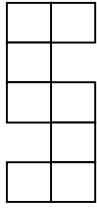
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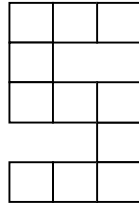
The Queen's Croquet-Ground #1

Utah's Largest Math Event (warm-up)

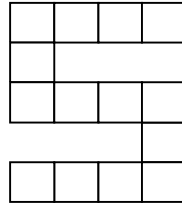
The Queen of Hearts is never satisfied. She is always changing the size of the croquet-ground.



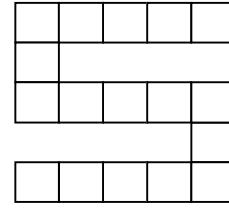
#1



#2



#3



#4

1. Describe what the 5th croquet-ground would look like. _____

Draw a sketch of this croquet-ground.

2. Predict the total number of squares needed for the 15th croquet-ground. _____

Explain your reasoning. _____

3. Write a rule that you could use to find the total number of squares needed for any croquet-ground in this sequence. _____

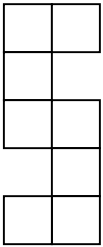
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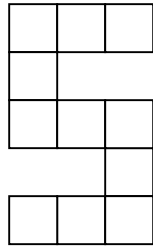
The Queen's Croquet-Ground #2

Utah's Largest Math Event (qualifier)

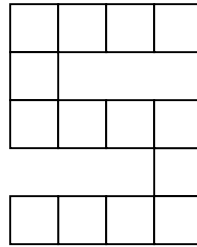
The shapes below show how the croquet-ground grows every time the Queen changes her mind. Now she wants the soldiers to build a new fence around each croquet-ground.



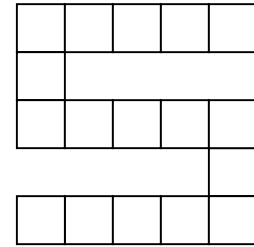
#1



#2



#3



#4

1. Use a pattern from the shapes above to determine the perimeter of the 5th shape in the sequence. Show or explain how you arrived at your answer. _____

2. Write a rule that you could use to find the perimeter of any shape in this sequence. Explain how you found your rule. _____
