

“The King’s Chessboard”



THE HOOK

- ◆ How many squares are on a chessboard?



KNOWLEDGE AND SKILLS

- ◆ Students will understand the effects of exponential growth in a pattern and be able to describe this pattern with an algebraic expression and in words.
- ◆ Students will be able to demonstrate and justify the use of exponential growth.
- ◆ Students will use observations and spatial perceptions.
- ◆ Students will record data.



STRAND STANDARD LEVEL BENCHMARKS

- ◆ Strand D Algebraic Thinking
- ◆ Standard 1 The student describes, analyzes, and generalizes a wide variety of patterns, relations, and functions.
- ◆ Strand A Number Sense, Concepts, and Operations
- ◆ Standard 4 The student uses estimation in problem solving and computation.
- ◆ Strand C Measurement
- ◆ Standard 2 The student compares, contrasts, and converts within systems of measurement (both standard/nonstandard and metric/customary).



MATERIALS

- ◆ “The King’s Chessboard” by David Birch
- ◆ Chessboard
- ◆ Sticky notes
- ◆ Calculators



CAREERS

- ◆ Scientist
- ◆ Medical Epidemiologist



SOURCE

- ◆ Tonya Massey, Beasley Middle School, Putnam County
- ◆ Jan Buckelew, Taylor Ranch Elementary School, Sarasota County
- ◆ Original *Opening the Gate* adaptation: Suzie Davis, Pinellas County and Linda Ferreira, Pinellas County

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ACTIVITY DESCRIPTION

- ◆ **Hook:** Ask students “How many squares do you think are on a chessboard?” (Have chessboard on display for students to see.) Tell students to write their predictions on a small sticky note.
- ◆ Have students share their predictions. (64 is the most common answer, but is not correct.) Do not tell the students that their answer is wrong; however, suggest that there is a more precise answer.
- ◆ Place a 1x1 square on the overhead. Ask students how many squares they see.
- ◆ Repeat with a 2x2 square grid. Allow students to answer until they realize that there are 5 squares in all. (4 1x1’s, and 1 2x2)
- ◆ Repeat with a 3x3 square grid. Again keep discussion going until they realize that there are 14 squares in all. (9 1x1’s, 4 2x2’s and 1 3x3)
- ◆ Have students with a partner complete a table showing the total number of squares for the 1x1 up to an 8x8. (204, the sum of the squares of 1-8) Discuss results as a class paying careful attention to patterns.
- ◆ Read the book “The King’s Chessboard” until you get to the eighth day of the process. Have students make a table to show the relationship between the number of days and the number of grains of rice. Have the students complete the table up to the 20th day in terms of grains. (Allow the use of calculators.)
- ◆ Now read the next couple of pages until you reach the 12th day when one ounce is sent. Ask students “How much rice will be sent on the 13th day?” (2 ounces) Have them fill in the table up to the 20th day in terms of ounces. Ask students for another name for 16 ounces. (1 pound) Continue to the 20th day in terms of pounds.
- ◆ Ask students what they think the next unit will be.
- ◆ Have students in groups of 3-4 make a character map (CRISS strategy – picture of character in the center then pictures surrounding it that describe the character) of either the king or the wise man, illustrating how they think the story will end. Students need to include illustrations of things they already know from the story and illustrations of their predictions. Allow students to display their work and have a reporter from each group describe their map.
- ◆ Finish reading the story, then allow time for a class discussion about the importance of patterns and exponential growth. Compare their sticky note predictions. Have students go back to the charts that they created and describe in words the pattern for finding the number of grains for the n th day. Challenge the class to write the rule as an equation.
- ◆ If the students do not mention it, revisit the fact that there are actually more than 64 squares on a chessboard.
- ◆ **Journal Question:** How would you have handled this situation if you were the king?

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EXTENSIONS

- ◆ **Parent Activity:** Have the students present the following situation to their parents and be prepared to share their parents’ responses: I promise to clean my room for 1 penny today, 2 pennies tomorrow, 4 pennies the third day, 8 pennies the fourth day and so on for 1 month. Do we have a deal?



ASSESSMENT

- ◆ Which of the following situations would generate the most money after 20 years? Which one would you choose? Justify your answer.
 - a) Receive \$200 a year for the first year, \$400 for the second year, \$800 for the third year, and so forth.
 - b) Receive \$20,000 a year.
- ◆ **Rubric:** The following is a general guideline for evaluating this assessment. Students’ choices as to which situation they would choose have no effect on their grade. Assessment is based on understanding of exponential growth.
 - 4: Student demonstrates complete understanding of exponential growth and chooses a) as generating the most money
 - 3: Student demonstrates a great amount of understanding of exponential growth and chooses a) as generating the most money
 - 2: Student shows some understanding of exponential growth and chooses a) as generating the most money but is unable to explain why
 - 1: Student chooses correct situation but has no understanding of exponential growth
 - 0: Student shows no understanding and chooses wrong situation



CONNECTIONS

- ◆ Biology – exponential growth

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Student Activity Page

Number of Squares on a Chessboard

	1 x 1	2 x 2	3 x 3	4 x 4	5 x 5	6 x 6	7 x 7	8 x 8
1 x 1								
2 x 2								
3 x 3								
4 x 4								
5 x 5								
6 x 6								
7 x 7								
8 x 8								
TOTAL								

Patterns:

“The King’s Chessboard”

Student Activity Page

DAY	GRAINS		
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Describe in words the pattern for finding the number of grains on the n th day.