Math Solutions®
PROFESSIONAL DEVELOPMENT

One Hundred Hungry Ants

A Lesson with Sixth and Seventh Graders

by Jennifer M. Bay-Williams and Sherri L. Martinie

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In One Hundred Hungry Ants, *by Elinor J. Pinczes (Houghton Mifflin, 1993), one hundred ants are marching toward a picnic and trying to figure out the marching formation that will get them there the quickest. Initially they march in a single-file line of one hundred ants, then in two lines of fifty ants, four lines of twenty-five, five lines of twenty, and, finally, ten lines with ten ants in each. In this lesson, taken from Jennifer Bay-Williams and Sherri Martinie's* Math and Literature, Grades 6–8 *(Math Solutions Publications, 2004), students represent arrays using dot paper to learn about prime, composite, and square numbers.*

Read *One Hundred Hungry Ants* aloud. Each time the ants rearrange themselves, ask students to predict what the next arrangement might be. After finishing the book, visit the story again and list the different ant formations on the board:

1 x *100*

2 x *50*

4 x *25*

5 x *20*

10 x *10*

Ask different students to represent each array on dot paper by thinking about each dot as an ant and drawing a frame around an array to illustrate the arrangement. (See end of lesson for blackline master of dot paper.) Students who represent 1 x 100 and 2 x 50 will have to cut and paste the dot paper to show them.

Then talk with the students about other possible ant arrangements, such as 20 x 5 and 25 x 4. List other possibilities on the board. For one hundred ants, there are nine different formations in all.

20 x *5*

25 x *4*

50 x *2*

100 x *1*

Explain how arrays with the same numbers but in different order—for example, twenty lines of five (20 x 5) and five lines of twenty (5 x 20)—would be different formations in the story. When ants march in five lines of twenty, five ants in front each lead a line of twenty ants; however, when they march in twenty lines of five, twenty ants in front each lead a line of five ants. Also talk with students about how arrays relate to another with the same numbers in reverse

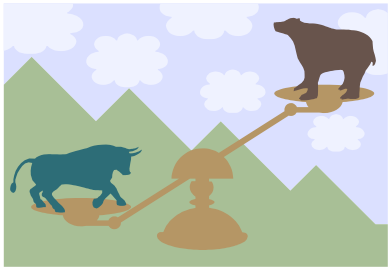
order; for example, if an array of four rows of twenty-five is possible, then an array of twenty-five rows of four is also possible. This is because four and twenty-five are a factor pair for one hundred. Point out that 10 is its own factor pair because 10 **x** 10 = 100.

Pose a question: "What if there were a different number of ants? Could we figure out how many formations would be possible?" Have students work in pairs and investigate this for the numbers from one to thirty. Assign two to three different numbers to each pair, either by distributing cards with the numbers from 1 to 30 on them or listing the numbers from 1 to 30 on the board and writing students' names next to them. Ask the pairs of students, for each of their numbers, to cut out all the arrays possible from dot paper, label their dimensions, and tape or glue them to a large piece of paper titled with that number of ants. If you think it would be useful, make color tiles or counters available for students to use to build the arrays. Post the students' displays in order from one to thirty.

A Class Discussion

As a class, examine the arrays posted and look for patterns that occur across the numbers. Use the following questions for discussion, incorporating appropriate vocabulary.

- Which numbers can be formed in exactly two ways—for example, seventeen rows of one and one row of seventeen? (These are prime numbers; all others except one are composite.)
- Which numbers have more than two possible arrays? (These are composite numbers.)
- Which numbers can be built in only one way? (Only the number one can be built in only one way; it is not prime or composite.)
- Which numbers have arrays that are also squares? (These are square numbers. These numbers have an odd number of factors.)
- Which numbers have an even number of arrays? (These are non-square composite numbers.)



EQUAL SHMEQUAL

by

Virginia Kroll

After watching two children at the playground, Mouse and her friends want to play tug-of-war but they can't figure out how to make equal teams. Should the teams be plant eaters vs. meat-eaters or fur vs. scales? The decision is finally made by weight.

To transition to these activities, remind your students of the animals' dilemma. Ask them to suggest ways, other than the ones suggested, which they might use to form teams. You may wish to read the book up to page 16, and pause to ask them to propose ways to form teams. Then finish the book and compare proposals. Make sure to review the concept of "equal" and "=", and the role the equal sign plays in an equation; each side must be equal for it to balance.

MATERIALS: Activity #1 - T Charts, animal names on sentence stripping, tape, markers. Activity #2 - 1 sheet of animal pictures (wolf, bobcat, deer, turtle, rabbit, mouse, bear) per child, 1 set of large, laminated pictures of the same animals (or plastic replicas or photos), scissors, glue, crayons/colored pencils (optional), paper to glue animals on, in order of size. Activity #3 – balance scale, weights, zipper/slide bags.

ACTIVITIES: Activity #1: Talk with the children about some of the ways the animals grouped themselves in the story. Make a T Chart of these groupings and other, e.g. carnivores vs. herbivores, fur vs. no fur, large vs. small, feathers vs. no feathers, etc. Encourage them to come up with other ways to sort them. Have them brainstorm other forest or woodland animals (pumas, foxes, moles, beavers, otters, owls, quail, woodchucks/groundhogs, squirrels, chipmunks, woodpeckers, jays, elk, ducks, moose, etc.) and continue sorting.

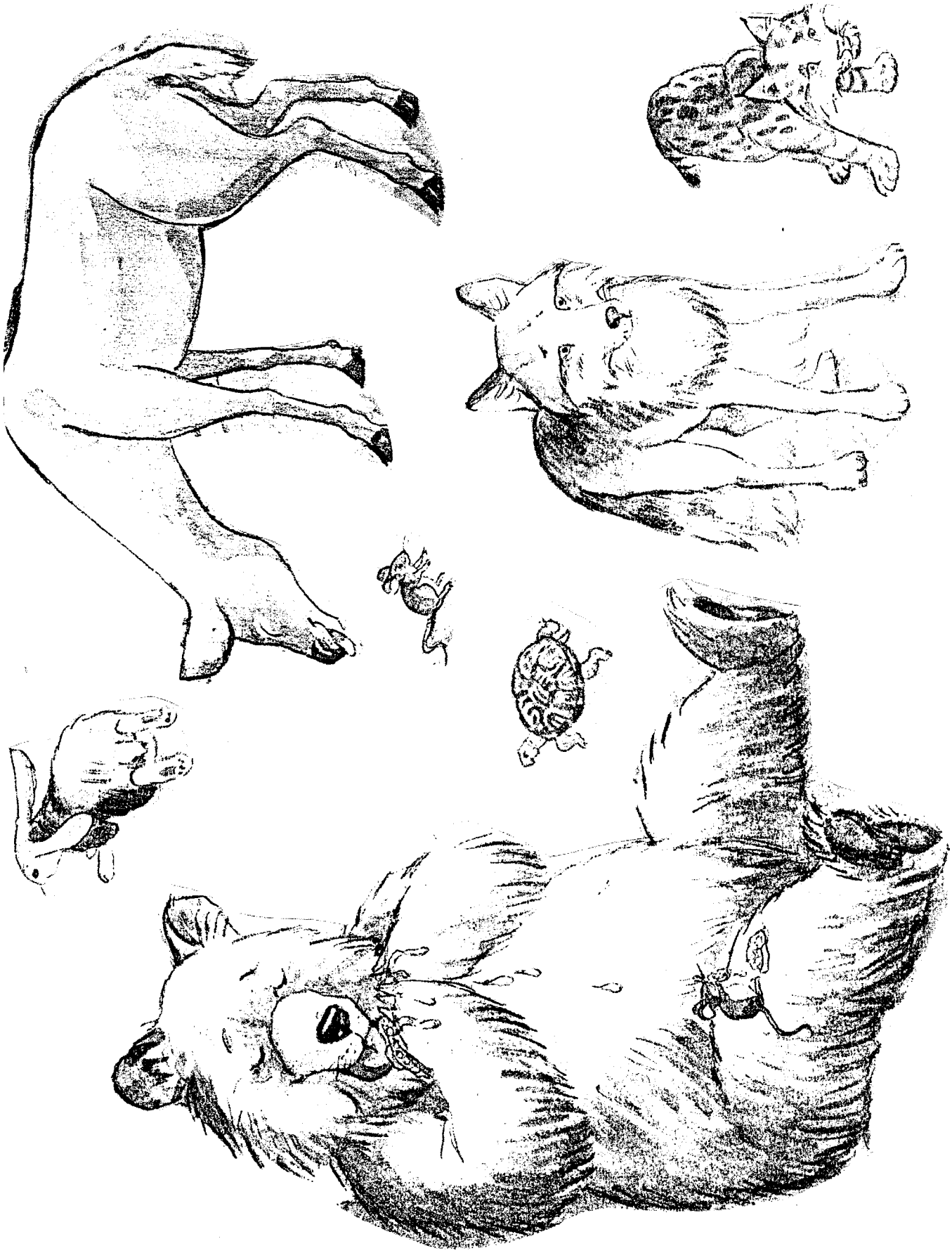
Activity #2: Using the large size animal cutouts, have your students take turns putting the animals in order from smallest to largest. Next, place all but one or two pictures on the chalk rail in the correct order. Have students place the missing animal(s) where they go size-wise. (Studies have shown that this concept or sense of "between-ness' is one of the hardest concepts for children to master.) Do this varying the missing animals, and number of missing animals, as time permits.

Activity #3 -- Experiment with varying combination to see what would actually balance. Determine a unit of weight to use to compare the weights of the animals (perhaps bear weights or pennies). How many units would equal the weight of each animal? You will probably wish to do this in advance or at least find out a range of possible weights. According to the American Bear Association, an average male black bear weighs around 2501bs. [My estimation for the weights of the various animals (just a guess!) is mouse =1, turtle = 4, rabbit = 15, bobcat = 35, Wolf = 65, deer = 145, bear = 266.] Allow the children to determine how they could use backwards thinking to find out the animals' various weights. " .....if the bear weighs _____ units, and the mouse weighs __units, how much would the weights of the other animals be?" If your playground is lucky enough to have a seesaw, take your students outside and have them experiment with each other. Ask your students how they think the teams would form equally if other animals such as those in activity #1 were added.

Kroll, Virginia. Equal Shmequal. Illus. by Philomena O'Neill. Watertown, MA, c2005. ISBN#1 570918910 In order to have fun at a game of tug-of-war, forest animals balance the teams by using a see-saw. Includes non-fiction math notes for meanings of equal.

WEBSITE LINKS:
http://www.wpsweb.com/gr11/wpslesson_bear_weigh.htm Website wit primary lesson plans
http://www.americanbear.org/Size.htm Website of the American Bear Association
http://www.polarbearsinternational.org/bear-facts/about-the-polar-bear/ Website of the organization Polar Bears International

STANDARDS:
BSL: 1.1, 1.2, 1.3, 1.4, 1.8, 1.11, 3.1, 3.3, 3.4, 5.1, 5.2, 5.4, 6.2, 6.3, 9.1, 9.7, 11.3, 12.1, 12.4, 12.8, 12.12, 12.14
NCTM: 1a, 1c, 2a, 3b, 3c, 4b, 4d, 4e, 5a, 5b, 5c, 5d, 6a, 1Oa, 10d, 13a, 13b
SCS: A1, A2, B1, C1, C3, H2, H3, H4, H5



"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

"The King's Chessboard"

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?

"The King's Chessboard"

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

“The King’s Chessboard”

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 *nth* day.