

Sharing Cake with King Lion: A Literature-Based Lesson for Grade 4

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This article is intended as a lesson plan; it addresses several outcomes in the number strand for Grade 4 mathematics through the use of a children's story, *The Lion's Share: A Tale of Halving Cake and Eating It, Too*, by McElligott (2009). There is ample research currently available that emphasizes the effectiveness of using children's literature in mathematics classes across all grades, and the natural progression of moving from stories to specific skills and concepts is evident to professionals who work with students (Martinez and Martinez 2000, 55). The lesson plan concludes with a detailed description of the mathematical processes addressed.

Synopsis

Ant has been invited by the king, Lion, to join him and his animal kingdom guests for a special dinner party. Once there, Ant is shocked at the other guests' behaviour; they are acting like atrocious animals! When the guests take more than their fair share of dessert, Ant offers to bake the king a delicious cake for the next day, an offer that the animals see as an opportunity to doubly outdo one another.

Mathematical Concepts

This book explicitly and effectively addresses the mathematical concepts of multiplication and division. The story begins by the animal guests taking half of the cake placed in front of them, no matter how little. For students who are being introduced to the concept of division, this would be an effective story to use for a discussion regarding fair sharing—"the idea of evenly distributing a quantity is the conceptual basis for division" (Baroody and Wilkins 1999, 59). The discussion would direct students' attention to the animals' misconceptions about taking half the cake without taking into consideration the number of animals left that must also have a piece.

The concept of multiplication is also clearly addressed, as illustrated in the following lesson plan. It is an effective story to introduce the process of multiplying one-, two- and three-digit numerals by 2, as each animal wishes to outdo the last by baking twice as many

cakes. This lesson could easily be adapted to include multiplying by larger numbers such as 3 or 4. The nature of this story facilitates the discussion of the inverse relationship between multiplication and division.

In later grades, this book may be used to help make fractions and ratios more meaningful. In Grade 5, for example, students are expected to "demonstrate an understanding of fractions by using concrete, pictorial and symbolic representations to: create sets of equivalent fractions; compare fractions with like and unlike denominators" (Alberta Education 2007, 18). The amount of cake left after each animal takes a piece can be represented as a fraction; the book even includes illustrations inside the front and back covers that show pieces of cake and their corresponding fraction. For example, after the elephant takes half, there is $\frac{1}{2}$ of the cake left; after the gorilla takes his half, there is $\frac{1}{4}$ left; after the hippo takes her half, there is $\frac{1}{8}$ left, and so on.

Lesson Plan

General Outcome: Develop Number Sense

Specific Outcome 6: Demonstrate an understanding of multiplication (two- or three-digit by one-digit) to solve problems by

- using personal strategies for multiplication with and without concrete materials,
- using arrays to represent multiplication,
- connecting concrete representations to symbolic representations,
- estimating products and
- applying the distributive property.
[C, CN, ME, PS, R, V]¹

Achievement Indicators

- Create arrays using transparent mirrors and represent pictorially.
- Estimate the number of counters that will appear in the arrays for numerals 5 to 8.
- Use personal strategies when manipulating base-10 blocks to solve multiplication problems involving two or three digits multiplied by one digit.
- Display multiplication work symbolically using personal strategies, including distributive property.

MATERIALS	DISPLAYS
<ul style="list-style-type: none"> • All students can choose to have paper and pencils out during this lesson to support their problem-solving strategies and to keep track of the number of cakes being offered to the king. • Book—<i>The Lion's Share: A Tale of Halving Cake and Eating It, Too</i>. Prepare the book for the lesson by blocking out the numbers and pictures showing the number of cakes blocked out on page 16 and following. • Transparent mirrors—groups of two or three students can share one mirror. • One bag of counters per table • Arrays diagram sheet • Laminated animal faces from the story: ant, beetle, frog, macaw, warthog, tortoise, gorilla, hippo and elephant (one set per group) • Sets of base-10 blocks 	<ul style="list-style-type: none"> • Have paper ready to write definitions and examples for the math word wall. Students will collaborate to generate definitions for the words <i>double</i> and <i>half/halving</i>.

TEACHER ACTIVITIES	STUDENT ACTIVITIES
<p>Introduction: Begin by having students explore doubles using arrays.</p> <ul style="list-style-type: none"> • Have students set up transparent mirrors at their table and share the counters between them. Two or three students can share one mirror. Allow them time to manipulate the counters, adding and taking them away from in front of the mirror. • Have students place one counter in front of the mirror and draw what they see in the mirror, representing the arrays pictorially. Have students make additional arrays by adding one counter at a time, up to 4 counters. • Have students estimate what is going to happen when they put 2 more counters in front of the mirror. Ask for their reasoning. Students complete the diagrams estimating and illustrating what their arrays will look like for 6, 8, 9, and 10 counters within their groups. Discuss with students; use probing question 1 from the assessment items. • Have students discuss what the word <i>double</i> means and collaboratively create a definition to be placed on the math word wall. • Show the students <i>The Lion's Share: A Tale of Halving Cake and Eating It, Too</i> and ask if any of them have read the book before. • If there is time, discuss the different meanings of the homonyms <i>having</i> and <i>halving</i>. Collaboratively create a definition for <i>halving</i> to be placed on the math word wall. This will be used in a later lesson. (Small 2009, 130) <p style="text-align: right;">[12 min]</p>	<ul style="list-style-type: none"> • Discuss what they notice while exploring counters in front of the transparent mirrors. • Create arrays; draw a picture of what they see using the arrays diagram sheet. • Estimate and provide explanations for estimates; complete the diagrams with their group members. • Discuss the word <i>double</i>. • Discuss the homonyms <i>having</i> and <i>halving</i>.

TEACHER ACTIVITIES (cont'd)

Development:

- Provide groups with one set of animal faces from the story. The ant face goes in the middle of the table. Each student is responsible for one or two of the other characters (ideal group size would be four students with two animal faces each).
- Provide groups with one set of base-10 blocks.
- Explain to students that you will be reading *The Lion's Share: A Tale of Halving Cake and Eating It, Too*. When the ant offers to bake the king a cake for the next day (p 15), ask the students to put one block on the ant's face in the middle of the table. Stress to the students that the rest of the animals are going to be *doubling* the number of cakes that they offer to bake for the king.
- While reading, leave out the number of cakes each character is going to make for the king. When it is their character's turn to offer to bake cakes, the students are to solve how many cakes are going to be made. Discuss with students; use probing question 2 from the assessment items.
- At the end of the story, have students tell the rest of the class the different strategies they used.

- Discuss the different ways that students could represent their work symbolically. Show the different strategies that students offer on the whiteboard and work through any misconceptions that arise. Encourage effective and appropriate strategies that represent multiplication. Discuss with students; use probing question 3 from the assessment items.
- Have students write their personal strategies in their math journals as a multiplication procedure.
- Have students remove all the blocks from their characters and ask them to solve for what would have happened if the ant had offered to bake the king two or three cakes.

[23 min]

STUDENT ACTIVITIES (cont'd)

- Place the ant face in the middle of the table and take one or two character faces for themselves.

- Listen to the story. Place one block on the ant's face when he offers to bake a cake for the king.

- Solve for how many cakes their character is going to offer to make for the king. Students can use paper and pencil to keep track of the other characters' numbers in the story, but they must use the base-10 blocks to arrive at their answer. Base-10 blocks may be used according to students' own personal strategies. Here are some possible strategies:
 - Students place blocks representing the factor given on the table in front of them. To find out the number of cakes that their character has to make, students may place the same number of blocks on top of the original ones and count them.
 - Students represent the known factor using base-10 blocks. To solve for how many cakes their character is going to offer to bake, they double each group of blocks (ones, tens, and hundreds) and simplify by regrouping the blocks that represent the product.

- Listen to peers talk about their explanations; offer individual strategies for showing work symbolically. A possible strategy offered may include the distributive property:
 - $2 \times 128 = (2 \times 100) + (2 \times 20) + (2 \times 8)$
 $= 200 + 40 + 16 = 256$

- Write their strategies as written expressions in their math journals.

- Solve the new problem. Students may use the same strategies as previously or may choose to use one of the strategies offered by their classmates.

TEACHER ACTIVITIES (cont'd)	STUDENT ACTIVITIES (cont'd)
<p>Closure</p> <ul style="list-style-type: none"> • Discuss with students what they noticed in the product similarities when the ant started with one cake and when he started with two cakes. • Discuss why the products were so different when the ant started with one or two cakes and when he started with three cakes. <p>[5 min]</p>	<ul style="list-style-type: none"> • Students may determine that all the products were the same because 2 was one of the products in the original problem. The difference will be seen with the elephant's character. Because the ant started with a higher multiple, it will result in a final product double that of the final product in the original problem. • Students may determine that because the ant started with three cakes and 3 was not a factor or a product in the original problem, all of the proceeding products will also be independent of the products from the original problem.

Differentiated Instruction

Differentiating for Above Readiness

- Using the original problem (the ant starts with 1 cake), have the students solve for how many guests were invited if the final guest offered to bake the king 512 cakes.
- Using the original problem, have students solve the problem if the animal guests wanted to triple the ant's original offer.

Differentiating for Below Readiness

- Ensure that students that need additional support are NOT solving for the hippo or elephant characters to begin with. Allow for practice with one- and two-digit numerals to begin with.
- Have students include another step during the development activity. The original activity has students transition from a concrete representation directly to a symbolic one. Have students who need additional support move from the concrete

representation, using base-10 blocks, to a pictorial representation to further deepen their understanding. The picture will be a permanent resource for students to refer to when they encounter more complex problems.

Assessment

To assess this lesson, use the following checklist and accompanying probing questions. Behaviours that directly reflect the specific outcome are listed along the top row of the checklist, and students' names are in the left-hand column (Small 2009, 608). Circle the appropriate indicator for each student. The probing questions are meant to support students' learning and provide more information about students' understanding. It is important to let students answer fully and to "not interrupt during the explanation. Errors and possible reasons for misconceptions should be noted and used later to re-teach the student" (Bryant and Pedrotty 1997, 64).

The Lion's Share: A Tale of Halving Cake and Eating It, Too: Multiplication Lesson

Student	Represents arrays pictorially	Makes an estimation to complete arrays	Uses base-10 blocks to support personal strategies to determine products	Makes a logical connection from strategies with base-10 blocks to a symbolic representation	Personal strategies include distributive property	Notes
	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	
	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	
	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	
	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	
	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	
	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	
	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	1 2 3 N/O	

1= never 2= sometimes 3=always N/O= not observed

Example Probing Questions

- Can you tell me why you drew 12 counters in your next estimation for 6 counters in front of the mirror?
- Ask about why students choose to use the base-10 blocks as they do.
 - Can you explain to me why you put the same number of blocks on top of the original number of blocks to determine the product?
- Can you explain your steps to me when you showed your work symbolically?
 - Why did you convert 128 into 100, 20 and 8?
 - Why did you add the products of the three equations?

Mathematical Processes

Communication—Students are given various opportunities to communicate with group members, the entire class and the teacher during this lesson. Students are encouraged to communicate with each other during the introductory activity, because they must share materials while exploring doubles in the transparent mirror. The teacher can listen for misconceptions as students talk in their groups about observations they make as they add counters or take them away from in front of the mirror. Students also engage in group discussion in the introductory activity when collaborating to develop mathematical definitions for the words *doubling* and *halving* for the math word wall.

As Small (2009) notes, it will be important to allow sufficient wait time after students contribute to allow other students to respond and add to the discussion (p 64).

During the development activity, students initially develop strategies on their own but tell the rest of the class about those strategies immediately after the story. To encourage listening, as suggested by Small (2009), once the strategies have been revealed there will be an opportunity for "... the listeners [to] describe what they learned from the explanations" (p 65). Students must also communicate information about symbolic representations that will be recorded in their math journals that can be used as a resource for future tasks. This written communication is important as it "... becomes available for later analysis and discussion ... and [can] help make mathematical relationships more obvious" (Greens 1999, 46).

Finally, students will communicate with the class during the closure about similarities and differences in the products of different multipliers.

Connections—This lesson gives students an opportunity to make connections between the introductory activity, in which they use transparent mirrors to explore doubles, and the development activity, in which they use base-10 blocks and symbolic representation to further explore the concept of multiplication.

The story also allows students to make connections to their personal lives. Some might have seen the animals from the book in a zoo or have attended a party where some of the guests took more than their fair share of dessert. Although these are not connections to mathematical concepts, Small (2009) stresses that "any and all connections are helpful for students to make sense of new ideas they encounter" (p 31).

Mental Mathematics and Estimation—During the introductory activity, students make estimations about what the arrays will look like in the transparent mirror for the numerals 5 to 8. This is done after they have practised using the counters to build arrays up to 4×4 and representing what they see pictorially.

Problem Solving—As advised by Small (2009), students are first given a context—in this lesson, taken from the story—and are then required to develop mathematical procedures to problem solve (p 38). Students use the events in the story as their reason for using the base-10 blocks to solve for how many cakes their character will have to bake for the king. This lesson follows Small's (2009) three recommendations for teaching problem solving in a meaningful way. First, there is "an increased level of mathematical dialogue between students" (p 38). This is evident as students not only discuss the meanings of mathematical terms, but also talk about their personal strategies and respond to peers' comments in all three

parts of the lesson. Second, there is an emphasis on "the teacher's role as a guide or coach more than as a presenter" (p 38). Students have time to explore manipulatives without being told how to use them. Students are also expected to develop and use personal strategies to problem solve—the teacher does not simply teach a strategy then expect students to use it. Rather, the teacher's role is to give students the materials needed for exploration and to provide the context for the lesson. Last, this lesson involves "the teacher's more judicious use of intervention" (p 38). While the teacher allows students to develop their own personal strategies, it is still the teacher's responsibility to encourage the use of effective and appropriate strategies and to help students realize and understand their misconceptions.

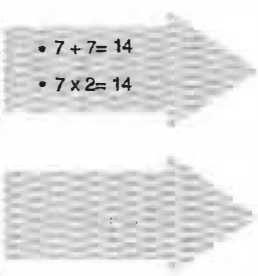
Reasoning—Students use reasoning skills throughout this lesson to generalize and verify conclusions (Small 2009, 30). The exploration of doubles in the introductory activity gives students an opportunity to begin to make inferences about the processes they are using. Those inferences can then be generalized during the development activity and verified through communication with peers and the teacher.

Visualization—Students can internalize images during the introductory activity. They are required to first represent their manipulatives as they see them in the transparent mirror. Then they must use visualization to estimate what the arrays will look like for the remaining numbers and represent those estimations using the arrays diagrams.

Notes

- The story can be used again for a division lesson on halving and for a fractions lesson.*
- Extension—What would happen if the animals wanted to triple the number of cakes they offered to bake?
- Math word wall additions—These will be organized with input from the class and placed on the math word wall for future references.

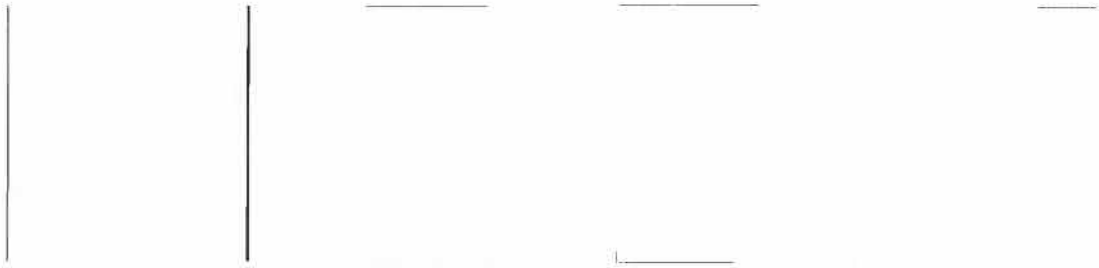
Double: Make something bigger by the same number or size as the original. With numbers, doubling can be done by adding a number to itself or by multiplying by 2.


$$\begin{aligned} &\bullet 7 + 7 = 14 \\ &\bullet 7 \times 2 = 14 \end{aligned}$$

Halving: separating something into 2 equal parts.

* Leave further explanation and examples for halving until later lesson on division.

Arrays Diagram Sheet



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[Estimation:

[Estimation:

Note

1. Key:

- C Communication
- CN Connections
- ME Mental Mathematics and Estimation
- PS Problem Solving
- R Reasoning
- V Visualization

Source: Alberta Education 2007, 4.

References

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