As the elementary mathematics curriculum continues to expand beyond an emphasis on arithmetic computation, measurement should play an increasingly important role in the curriculum. Principles and Standards for School Mathematics (NCTM 2000) states that pre-K through second-grade children should understand attributes, units, and systems of measurement; recognize the attributes of length; compare and order objects according to these attributes; make and use measurements in natural situations; apply a variety of techniques and tools for determining measurements; use tools such as rulers to measure; measure with units of the same size (nonstandard and standard); and use repetition of units (iteration) to measure length. Tasks that focus on these measurement ideas provide a natural opportunity to incorporate recommendations from the Number and Operations Standard, namely, learning how to represent numbers, learning to count fluently with understanding, and developing an understanding of the relative magnitude of whole numbers.

Children's literature is one avenue through which to design tasks to engage students in exploring mathematics concepts (Whitin and Wilde 1992, 1995; Burns 1992; Braddon, Hall, and Taylor 1993). This article discusses the use of the book The Grouchy Ladybug (Carle 1977) to integrate mathematics and language arts so that students explore feelings through reading and writing and connect concepts of number to concepts of length. The activity would follow informal work with measurement using common objects in the classroom, such as pencils, paper clips, white-board erasers, or students' fingers and feet, as the units of measure.

**Setting the Stage**

The Grouchy Ladybug became the theme of a day of activities for first graders that integrated language arts, mathematics, and social skills. Mathematically, students used nonstandard units of measure, counted and wrote numbers, and demonstrated use of one-to-one correspondence. Cooperative behaviors to promote social interactions supported the language arts, areas of reading, writing, listening, and speaking. The day's activities took about two and a half hours, with breaks for recess and lunch.

The day began with reading and discussing *This Is the Bear* (Hayes 1986), a story about a grouchy bear who is pushed into a trash can and ends up in the dump, and *And I Mean it Stanley* (Bonsall 1974), a story about a grouchy boy who uses items from a junk pile to build things while repeatedly telling his dog, Stanley, to stay away from him. The teacher encouraged the students to share how the characters in the stories felt about their respective situations.

The class then was ready to begin writing a new story. The teacher asked students to think about things that made them grouchy and recorded responses on the board in a web around the word grouchy. Students' responses included "When someone picks on me" and "When someone's mean." Using the web as a pre-writing guide, the class worked together to write a story titled Grouchy, which the teacher wrote on the board.

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Then students wrote their own grouchy stories in their journals. Topics ranged from having to share things to being awakened early to having to go places they did not want to go. Students wrote words by sounding them out and using approximate spelling. They edited their own writing by consulting their word books and the classroom word wall. Students also illustrated their writing. Finally, they shared their stories with their neighbors.

Reading the Story

When all the students had finished writing, editing, and sharing their stories, the stage was set to begin the mathematics activities based on *The Grouchy Ladybug*. In this story, a hungry ladybug unwilling to share the aphids on a leaf with another ladybug sets off to find her own leaf. Along the way, she encounters a variety of animals and attempts to pick a fight with each of them. Each successive animal is larger than the previous one.

After reading the story, the teacher asked the children to compare the size of the ladybug to the size of each animal in the story. The children noticed that the ladybug gets smaller in each picture, both in relation to the different animals and as she appears on the page. When asked why the ladybug seems to be smaller on each page, students mentioned that the animals on the page would not fit if they were drawn at their real sizes, so they had to be drawn smaller. The ladybugs also had to be drawn smaller or they would look too big next to the bigger animals.

The teacher asked, “If we lined up ladybugs on the stag beetle’s back, how many ladybugs would fit?” Students suggested that they would have to draw ladybugs the size of the one on the page and see how many fit. When asked how they would arrange the ladybugs, students said, “Line them up next to each other.” At this point, the teacher showed the class a tape measure on which ladybugs were lined up as they suggested. There were no numbers on the tape measure; students had to count the appropriate number of ladybugs when measuring (see fig. 1).

Labeling the Ladybug Tape Measure

Although students had measured objects using the lengths of their fingers, shoes, pencils, and other common objects in the classroom prior to this activity, only one student had ever measured any-
Estimation sheet

Names: ____________________________________ __

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<th>Classroom Object</th>
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thing with a tape measure. Modeling as she talked, the teacher asked students how she should place the ladybug tape measure to find the number of ladybugs that could be lined up on the edge of the pencil case. After several tries, students told the teacher to line up one of the ends of the tape measure with the end of the pencil case and then place the tape measure along the edge of the pencil case. They told her that using the middle of the tape measure would make it more difficult to decide how many ladybugs could line up on the object.

After measuring a few items and counting the number of ladybugs each time to determine the length, students suggested writing numbers next to the ladybugs so they would not have to count each time. The teacher gave each pair of students a tape measure to number the ladybugs, an activity that demonstrated students’ informal understanding of one-to-one correspondence between numbers and ladybugs. Because some groups of students labeled their ladybugs with different numbers, the teacher asked students to count the ladybugs with her. They found that there were thirty ladybugs on the tape measure and corrected their labeling.

Estimating and Measuring
When students finished numbering their tape measures, they had three to four minutes to engage in free exploration with these measuring tools. Most students took care to position the end of the tape measure within a quarter-inch of one edge of the object they were measuring. The few students who initially measured without paying attention to which end of the tape they were using caught their mistakes and fixed their measurements.

With their ladybug tape measures complete, students now were ready to focus on the main mathematical task of the day: measuring classroom objects. The teacher gave students the estimation sheet in figure 2. While asking students questions to obtain the necessary information, the teacher modeled writing the name of the object, making and recording an estimate of the length, and then obtaining and recording the actual measurement. The teacher repeated this process twice more with students so that the class estimated, measured, and recorded ladybug lengths of three different objects: a book, a CD player, and a child’s smallest finger.

Students in each pair estimated and then measured six objects of their choice, recording their work on the estimation sheet. Figure 3 shows students measuring a pencil case with the ladybug tape measure. For most students, the first few estimates were random guesses. As they measured and became more familiar with the size of the ladybugs, their estimates improved. Several pairs turned this activity into a game to find who could estimate closer to the actual length of each object. Students in one pair did not feel comfortable estimating lengths; they held their tape measure over
an object without actually touching it and then eyeballed the length. That their estimates and actual lengths were identical for every object was no surprise. Students in another pair could not agree on the lengths of objects when a partial ladybug was involved. One student insisted on using the greater number of ladybugs even when only a very small part of the next ladybug overlapped the object they were measuring. His partner wanted to use the lesser number of ladybugs. Their argument led to further discussion about accuracy in measurement and rounding numbers when the teacher extended the activity later in the semester.

**Ordering from Shortest to Longest**

As a follow-up task, the teacher asked children to use the ordering sheet (see fig. 4) to order their measurements from shortest to longest. Students wrote each object’s name, drew a picture of the object, and entered the length in ladybugs (see fig. 5). Recording the measurements in order from shortest to longest on the ordering sheet was easy for the students and provided an opportunity for students to indicate their number sense. Students who had two objects of the same length wanted to record them in the same box on the ordering sheet; they recognized that objects whose measurements were the same number of ladybugs were the same length.

**Students' Booklet**

Students had enjoyed creating class books on previous occasions, so they suggested that they make their own book to accompany *The Grouchy Ladybug*. To create the class book, children chose an object from their ordering sheet to draw on a separate page. They recorded the name of the object and its length in ladybugs on the page. When asked how the pages should be arranged, students...
Estimating and ordering objects favored the arrangement in *The Grouchy Ladybug* of shortest to longest. The teacher solicited student suggestions for collecting the book pages this way. One student suggested ABC order, probably because the class had recently worked on alphabetizing words. When asked to construct a similar pattern with numbers, students suggested starting with 1 and ending with 30. While students held their pages, the class counted out loud beginning at 1; students submitted their pages for the class book as the class called out the ladybug length of the object they had drawn. After the pages were in the correct order, the teacher read the book to the class. Students enjoyed hearing classmates compliment their drawings.

**Comparison of Nonstandard and Standard Units**

As a wrap-up, the teacher focused students' attention on the difference between ladybugs and inches as units of measure. Several students had referred to the units in which they were measuring as inches instead of ladybugs. Students compared lengths measured in inches to the lengths of the same objects measured in ladybugs and observed that the values were different. This created a natural opportunity to stress the importance of writing the units that they used to measure.

Students had measured a variety of objects, some of which were curved, such as the distance around heads and wrists. The class discussed the use of a rigid measuring tool such as a pencil or a ruler versus a flexible tool such as the ladybug or inch measuring tape. The teacher asked students to estimate the distance around heads, ankles, and wrists. They discovered that using a ruler to make such measurements was difficult and decided that the tape measure was a better choice for measuring curved objects.

**Revisions and Extensions**

Because of time constraints in the first-grade class, the teacher decided not to address the issue of measurements that are not a whole number of ladybugs. A follow-up activity on another day in which students measured items that required the use of partial ladybug measures acted as a natural introduction to rounding to the nearest unit of measure and the need for accuracy.

**Conclusion**

This article has illustrated how teachers can use a particular children's book to engage first graders in measurement tasks while they develop number concepts. The tasks described in this article integrate not only the two mathematics strands but also language arts and social interactions. Study of different animals and their habitats provided additional connections to science.

Working together to measure classroom objects, children engaged in cooperative problem solving as they learned the appropriate way to use the measuring tape. They also had multiple opportunities to engage in mathematical discourse, both in pairs and in whole-class discussions about the task.

This kind of activity is a precursor to the more formal use of a standard ruler. Activities such as those that Liedtke (1990) describes, which formally introduce students to the use of a ruler marked in inches, can follow. Using ladybugs to measure objects was a concrete experience for students that can lead to the abstract notion of inch. *The Grouchy Ladybug* served as the backdrop for a rich mathematical task and a theme for a morning's study. We encourage others to find similar books that facilitate integration of mathematics strands as well as content areas.