Minilesson: A Multiplication String (10–15 minutes)

- Work on a string of quick images designed to encourage students to use partial products to find the products of larger arrays.
- Use the open array to record students' strategies, delineating the smaller arrays used.

This mental-math minilesson uses a string of related quick images (Appendix C) designed to encourage students to use partial products to find the products of large arrays. As you did on Day Five, show one image at a time briefly and then turn off the light on the projector or cover the image as you ask students to determine how many truffles are shown and to explain how they know. Record the strategy shared on an open array, delineating the smaller arrays used.

String of related quick images:

2×5

1×5

3×5
(made with one 2×5 box and one 1×5 box)

5×4
(made with two 2×5 boxes vertically)

4×5
(turn the 5×4 array 90 degrees)

5×5
(made with two 2×5 boxes and one 1×5 box)

Behind the Numbers

The numbers in the string were chosen to continue to develop the idea that small arrays can be used to build larger arrays. Only two small arrays are used, a 2×5 and a 1×5, to give students a better chance of determining what is shown since the arrays are seen only briefly. As you use the 2×5 and 1×5 to make the other images, leave only a slight space between them to enable students to see them easily while keeping them intact as an array. The quick image technique encourages students to progress beyond counting by ones in figuring out the area and to consider other strategies, such as skip-counting or using partial products. The string also provides an opportunity to use the open array as a representation. The first two problems are used to make the third. The fourth and fifth problems will generate a discussion on the commutative property. The last problem requires partial products again.

Preparing for the Math Congress

- Give students time to complete their new box designs and then ask them to prepare posters of their strategies.
- Encourage students to determine if they have found all the possible boxes.
- Conduct a gallery walk to give students a chance to examine each other's box designs and strategies.
- Plan to focus the congress (to be held on Day Seven) on developing the array as a tool for modeling the commutative, distributive, and associative properties.

After the minilesson, allow students time to finish their work on the assortment box blueprints, and then ask them to prepare posters for a math congress to be held on Day Seven. As students work, help them examine the question of whether or not some of their boxes are congruent. Remind them that the goal is to develop blueprints of *different* designs. Where you think it is appropriate, press students to determine if they have found all the possible boxes. This question may be just the thing that will bring students to consolidate and construct the big ideas this investigation is designed to support. Remind them that the task is to find different boxes, not different arrangements of the flavors, and encourage them to find a way to organize their work. For example, they might record all the different boxes for assortments of two flavors, (2×10, 4×5) and then for three flavors, etc., or they might organize by keeping one dimension constant (all the boxes with eight rows, 8×5, 8×10).

Plan on having a gallery walk toward the end of the math workshop today. Since some students will probably have designed boxes that others have not thought of, the gallery walk will allow students to examine a variety of boxes and strategies. If they see a box they did not make, they will be pushed to examine ways to systematize their work, and they will need to analyze for equivalency and congruence. Discussion of the commutative property may also arise during the gallery walk as students determine congruency (such as 8×10

and 10 × 8). Discussing strategies and different boxes during the gallery walk will allow you to focus on just a few big ideas during the congress on Day Seven.

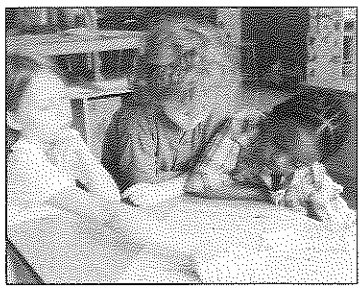
For the gallery walk, pass out pads of sticky notes and suggest that students use them to record comments or questions. These notes can be placed directly on the posters. Display all the posters around the room and have the students spend about fifteen minutes walking around, reading and commenting on the mathematics on the posters. Then provide time for students to read the comments and questions attached to their own posters.

Tips for Structuring the Math Congress

Plan on focusing the congress on Day Seven on developing the array as a tool for modeling the commutative, distributive and associative properties of multiplication. Choose two or three posters to scaffold the conversation. For example:

- Begin with the work of students who noticed a pattern in their recording sheet (the pattern went by twos: 2 × 5, 4 × 5, 6 × 5, etc.) but do not yet understand why this pattern occurs.
- Then move to a pair of students who used the array to model distributivity: how a 4 × 5 can be thought of as two 2 × 5 arrays because (2 × 5) + (2 × 5) = 4 × 5.
- Then ask a pair of students who examined the other pattern (how the length of the array increases by five) to display their poster, and ask the class to consider, in light of the previous discussion, what might be making this pattern happen. Use notation to represent these ideas—(2 × 5) + (2 × 5) = 2 × 10—and to highlight which dimension stays the same and which dimension changes.
- If any students have developed a way to explain doubling and halving (a way to model why 4 × 5 = 2 × 10), you might discuss their poster next. A piece of work like this may be too difficult to consider at the beginning of the congress, (especially if students have not yet considered this idea). However, the prior discussion of distributivity will support students as they think about doubling and halving and the associative property.
- At the end of the congress, shift the conversation to the questions "Do you have all the boxes?" and "How can you be sure?" If some students have systematized their work, let them defend their systems.

Reflections on the Day



Quick images were used again today to support students in envisioning how small arrays could be used to make larger arrays. The minilesson also allowed you to use the open array to model the computation strategies students were using as they found solutions for the quick images. A gallery walk provided time for students to examine each other's work and to rethink whether they found all of the possible boxes and how they might have proceeded more systematically.