Multiplying With More Than Two Numbers

In Session 1.4, students are working on finding ways to multiply with whole numbers to make the products 18 and 180. In the middle of the session, the teacher stops the class for a few minutes to share how they are generating different ways to multiply more than two whole numbers to make 180. She starts by asking students about their work on 18.

Teacher: At the beginning of class, we found all the ways of multiplying two whole numbers to make 18. (Points to this list on the board: 1 × 18, 2 × 9, 3 × 6). How did you find three numbers that you can multiply together to equal 18?

Lourdes: 3 × 3 × 2 will make 18.

Teacher: How do you know?

Lourdes: I multiplied it out and also used 9 × 2. I know that 9 = 3 × 3 so 3 × 3 × 2 will equal 18.

Teacher: [to the class] Does 3 × 3 × 2 = 18?

Class: Yes!

Stuart: There are more that will work, too! 2 × 3 × 3—oh wait, those are the same factors, just in a different order. I got them from starting with 3 × 6.

Teacher: How about 180? What numbers can you multiply together to get 180?

Tamira: All you need to do is add a 0 to one of the numbers in the ones we have for 18.

Stuart: What do you mean, "add a 0"?

Tamira: You multiply by 10. So, instead of 3 × 3 × 2, you could have 30 × 3 × 2. 30 × 3 = 90 and 90 × 2 = 180!

Mercedes: I got a whole list of them. I kept making each number smaller and smaller. [The teacher records Mercedes' ways to make 180 on the board as she says them.] I had 2 × 90, so I broke the 90 into 2 × 45, to get 2 × 2 × 45. Then I broke the 45 into 9 × 5, so I got 2 × 2 × 9 × 5. Then I broke the 9 into 3 × 3, and I got 2 × 2 × 3 × 3 × 5.

Teacher: Why did you stop there?

Mercedes: I couldn't break any of the numbers down any more.

Teacher: Why not? Why can't Mercedes break 2 × 2 × 3 × 3 × 5 into more numbers?

Margaret: Because, like 2, you can't split it. You can only say 2 × 1, and we decided not to use 1s because they'd just make it go on forever.

Olivia: Those are called square numbers, I think.

Janet: No, square numbers are like 3 × 3 = 9 or 2 × 2 = 4.

Rachel: They're prime numbers. They're the ones where we could only make one rectangle.

Teacher: That's right. These are prime numbers because the only factors they have are 1 and themselves. Keep thinking about how you can break up one way of multiplying to get other ways as you work with 180. Also keep thinking about what happens when you end up with prime numbers, like Mercedes did. Does that happen for other numbers? We'll be talking more about these ideas in the next few sessions.

When Mercedes noticed that her multiplication combination consisted of only prime numbers (2 × 2 × 3 × 3 × 5) and that she could not break down any of the factors further by using multiplication of whole numbers, Mercedes had found the *prime factorization* for 180. Mercedes and her classmates may not yet realize that 2 × 2 × 3 × 3 × 5 is not only the longest multiplication combination for 180 that is possible using only whole numbers greater than 1, but it is also the only way to make a product of 180 by multiplying five whole numbers greater than 1. For mathematicians, the fact that every whole number has a unique prime factorization is a central law of arithmetic. See **Teacher Note:** Finding Prime Factors, page 154.

For fifth graders, this work provides an opportunity to develop building blocks for understanding the properties of numbers in a context that is intriguing and engaging. At the same time, students continue to improve their flexibility in solving multiplication problems by using one multiplication combination to find other equivalent combinations. In Sessions 1.6 and 1.7, after students have done more work on finding ways to multiply whole numbers to create different products, they continue this discussion.