One Time Only

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Developing Number Sense, Grades 3–6, *is a new teacher resource book written by Rusty Bresser and Caren Holtzman. The book contains 13 lessons, each tested by Rusty and Caren in several classrooms. All of the lessons focus on developing strong number sense in students. Each activity has four components: an overview that identifies the math understanding and skills supported by the lesson; specific teaching directions; an extended vignette that describes what really happened when the lesson was taught to students; and answers to one or more reflective questions. Following is an excerpt from one of the activities, One Time Only. I tried the activity with fourth and fifth graders, and it was terrific. Of course, the lesson unfolded in its own unique way in my classroom, as it will in yours. Enjoy it with your students!*

Overview

Upper elementary students benefit from activities that help reinforce their understanding of factors, multiples, and prime numbers. In this two-person game, students take turns identifying factors of successive numbers, continuing until one of them can no longer contribute a new number.

Directions for Playing the Game

1. Player 1 writes down a number greater than one and less than 100.

2. Player 2 writes down a factor of the first number underneath it.

3. Player 1 writes down a factor of this new number.

4. Each player, taking turns, writes down a factor of the preceding number.

5. If a player writes down a prime number (i.e., it is not divisible without a remainder by any other integers except one and itself), the next player adds seven to it and writes down the resulting sum as his or her turn.

6. The player who can no longer contribute a new number loses the game.

Additional Rules

1. Once a number has been written down, it can't be used again.

2. The number one can't be used at all.

Caren Introduces the Activity

"Today I have a game for you," I announced to the sixth graders in Lyndsey Lovelace and Shea Carrillo's class. "It's called One Time Only. To play the game you need a partner. One of the partners begins by picking a number greater than one and less than 100. So you can see how it works, the whole class will be my partner for this first game. There are just a few rules, and I'll explain them while we play."

I wrote *36* on the overhead.

"Now it's your turn," I said. "You need to think of a factor of 36. Can anyone tell me a number that goes evenly into 36? Another way to think about it is by skip counting. Which numbers can you skip count by and get to 36?"

By introducing several ways to think about factors, I hoped to explain the game more quickly. If I'd just asked for a factor of 36, students who weren't sure what a factor was or who weren't sure about the difference between a factor and a multiple might not have been able to participate. As the students used the terminology in the context of the game, they'd become more comfortable with it.

"So, what do you think?" I asked. "Can anyone tell me a factor of 36?"

"How about six?" offered Fred.

"Is six a factor of 36?" I asked the class.

Several students nodded or vocalized their assent. I pushed for more of a commitment. "Who can explain why they think six is a factor of 36?" I asked.

Jessie raised her hand. "Because six times six is 36," she explained.

"Also," added José, "if you count by sixes you'll say 36. Like 6, 12, 18, 24, 30, 36."

"All right," I said, "I'm convinced that six is a factor of 36." I wrote 6 under 36 on a projected transparency. "Now I need to find a factor of six to add to the chain of numbers we're making here. I think I'll say two." I wrote 2 under the 6. "Okay, now it's your turn to think of a factor of two," I said.

"Two," said Derek. "Two times one is two."

"Well, yes," I responded, "two is a factor of itself, but one rule is that you can't use the same number twice. That's why the game is called One Time Only. If a number is already written down you can't use it again. Can anyone think of a factor of two that's not already up here?" I asked, pointing to the overhead.

"One," said Ali.

"Well, that brings up another rule in One Time Only. You can't use one. You're correct, Ali, that one is a factor of two. But in this game you're not allowed to use one. So you can't use a number that's already up there and you can't use one. Those are the two main rules of this game. Can you think of any other factors of two?"

"How about four?" asked Chrissy.

"How do you know four is a factor of two?" I inquired.

"Because two times two equals four," Chrissy explained. Chrissy had confused factors and multiples. I was glad she had made the multiplication connection, but I needed to prompt her a bit to get her back on track.

"I know that two is a factor of four, because I can count to four by twos," I said to her. "But it doesn't work the other way around. Four isn't a factor of two, because you can't count to two by fours."

"Oh, yeah," Chrissy replied.

"Does anyone know what we call four in this situation?" I asked the class.

"A multiple!" exclaimed Neal. "If you can times a number to get the number it's a multiple. Like 36 is a multiple of six because six times six is 36."

"All right," I continued, "so are there any factors of two besides two and one?"

"Can we use fractions?" asked Howard.

"Sorry," I told him, "but factors need to be whole numbers, like the numbers you use to count. Take a minute and talk at your tables," I suggested. "See if you can think of any other factors of two."

I let the students talk briefly and then I called them back to attention. "Did any tables find any other factors of two?" I asked. The class consensus was no. "So, do you think there are any other factors of two?" I prodded, checking to see if the students were really convinced.

"Not if we can't use fractions," Ana qualified.

"Well," I told the class, "you're right. There are only two factors of two, two and one. Does anyone know what you call a number that only has itself and one as factors?"

"Prime?" Greg ventured in a barely audible tone.

"Prime!" several students announced with authority after hearing Greg.

"Yes, those are prime numbers." I wrote *prime* next to 2 on the overhead. "In One Time Only when you hit a prime number you add seven to it. So what's two plus seven?"

"Nine," several students responded.

I wrote 9 on the overhead under the 2.

"Okay, now it's my turn, and I need to think of a factor of nine. I'll say three," I said, as I added 3 to the list on the overhead. "Now you need to find a factor of three."

"It's prime," announced Natalie with authority.

"If it's prime, what happens?" I asked.

"Add seven," José reminded us. "So it's ten."

I wrote prime next to the 3 and put a 10 below it.

"How many times can you use plus seven?" Jessie asked.

"There's no limit," I explained. "Anytime you're playing and a prime number comes up, you just add seven to it. It's my turn again and I need to put a factor of ten that's not already listed. I'll say five."

"Oh no," exclaimed Alejandro, "another prime number for us."

I raised my eyebrows in feigned surprise as I looked at the numbers on the overhead. "Wow, it is a prime number." I agreed. "You keep getting prime numbers on your turn. I wonder if that always happens in this game. Maybe there's a pattern." While I knew that this particular pattern didn't always happen, I took the opportunity to spark a little curiosity. I hoped that in subsequent games students would pay more attention to patterns in general as they played. Looking for patterns is a powerful way to build number sense, particularly when students have opportunities to think about the patterns and their relationships to numbers and operations. I referred to the string of numbers on the overhead, which now looked like this:

36

6

2 prime

9

3 prime

10

5 prime

"Okay," I said to the class, "it's your turn and since five is prime, what do you need to do?"

"Add seven," Jasper replied.

"Right," I agreed, "so now it's 12." I wrote *12* on the overhead. "Hmm," I said, "I need to find a factor of 12 that's not already up here." I paused for a few seconds to give students a chance to review the numbers and think about factors of 12. I also wanted the students to see that math involves taking time to think.

"I know," I brightened, "I'll say four." I wrote *4* on the overhead beneath the *12.* "Now you need to find a factor of four that's not already up here. Talk at your tables for a minute or two and see what you can come up with."

"We're stuck," Ali soon announced.

"What do you mean?" I asked.

"Well," Fred explained, "we're not allowed to use one. Four and two are used already. There are no other factors, so we can't go."

"Does everyone agree with Fred and Ali?" I asked, looking around.

The nods and yeahs were unanimous.

"Then I guess the game is over," I said. "This time I won, because I was the last player to add a number to the list. You want to get your partner stuck so she or he is unable to add a number to the string. But winning isn't really the important part of this game. You're going to play a bunch of times, and sometimes you'll win and sometimes you'll lose. The important part of the game is the mathematical thinking that you do."

I played one more game with the whole class. This second game went more quickly, because I didn't need to stop to explain the rules and vocabulary. After two games, I was satisfied that the students understood the rules and knew how to determine a winner. The factor concept had been reinforced, the term *multiple* had been introduced in context, and the students knew how to identify prime numbers. The students were ready to play with their partners. In addition to having practice with multiplication facts, students who play One Time Only search for winning strategies by thinking about relationships among numbers and factors. In so doing, they build their number sense.