LOOSE CABOOSE

NUMBER

- Division
- Multiplication

Getting Ready

What You'll Need

Snap Cubes, 27 per pair
Dice, 1 die per pair

Overview

Children play a game in which they roll a die to determine how many trains of equal length to build from a pile of 27 Snap Cubes. They write a division sentence to describe what happens during each turn. In this activity, children have the opportunity to:

- view division as making same-size sets
- practice using division symbolism
- look for patterns in division problems

The Activity

You may have to explain that the caboose is the last car on a freight train.

You may want to play a game of Loose Caboose *with children before they begin* On Their Own.

Introducing

- Show children a pile of 17 Snap Cubes. On the chalkboard, write $\overline{)17}$.
- Ask a volunteer to roll a die. Use the number that comes up to determine how many trains of equal length to build. Build that number of trains and set aside the remaining cubes, or the "loose caboose." For example, if the volunteer rolls a 3, form 3 trains of 5 cubes each and set aside the 2 leftover cubes.
- On the chalkboard, finish the division problem $3\overline{)17}^{\,5}$ R2. Identify 3 as the number of trains, 5 as the number of Snap Cubes in each train, and 2 as the remaining number of Snap Cubes, or the loose caboose.
- Now set aside the 2 loose caboose cubes and use the Snap Cubes that are left to write a new division: $\overline{)15}$. Have another volunteer roll the die and repeat the activity.

On Their Own

Play *Loose Caboose!*

Here are the rules.

1. This is a game for 2 players. The object is to wind up with more Snap Cubes.
2. Start with a pile of 27 Snap Cubes. Decide who goes first.
3. The first player writes the beginning of a division problem, $\overline{)27}$, and rolls the die to find out how many trains of equal length to build from the 27 cubes.
4. The first player builds the trains and keeps any "loose caboose" cubes that are left after the trains are built. Each of the trains should be as long as possible.
5. The first player completes the division problem. For example, if a 4 was rolled:

   6 ← Number of cubes in each train

   Number of trains → $4\overline{)27}$ R3 ← Number of loose caboose cubes

6. If there are no loose caboose cubes, the player still completes the division.
7. The second player begins his or her turn using the cubes that are left. In the example above, there were 3 loose caboose cubes, so the second player would begin with 24 cubes and write $\overline{)24}$.
8. Players take turns until there are no Snap Cubes left.

- Play at least 2 full games of *Loose Caboose.*
- Look for patterns in the division problems.

The Bigger Picture

Thinking and Sharing

Have children post their division problems with a remainder of zero in one column. Do the same for division problems with remainders of 1, 2, 3, 4, and 5.

Use prompts such as these to promote class discussion:

- What patterns did you notice?
- Which numbers could you make into 2 trains with no leftover cubes? Into 3 trains? 4 trains? 5 trains? 6 trains?
- What happened when you rolled a 1?
- Which numbers always had leftover cubes unless a 1 was rolled?
- Which numbers had the greatest number of ways to get a remainder of zero? What happened in the game when these numbers came up?
- Which numbers and roll of the die would give you the greatest number of loose caboose cubes in one turn?

Drawing and Writing

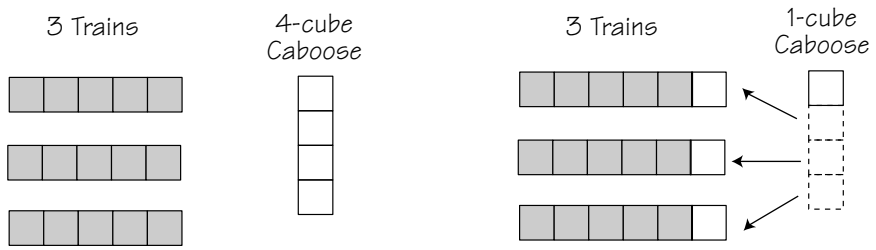
Ask children to write or draw a description of all the ways 24 Snap Cubes could be divided into trains of equal length.

Teacher Talk

Where's the Mathematics?

This activity provides an introduction to the concept of division as the partitioning of a set into equal-sized groups. It also conveys the meaning of the remainder. Multiplication facts are reinforced when the children start the next round of play and have to determine how many Snap Cubes are left so they can begin their division problem.

Children are likely to note that 1 is a divisor of every number; in other words, dividing by 1 always leaves a remainder of zero. Children are also likely to point out that the remainder (the number of cubes in the loose caboose) is always less than the divisor (the number of trains). Children can verify this by examining the trains and the number of caboose cubes. If the number of cubes in the loose caboose is equal to or greater than the number of trains, then each of the trains can be made longer.



Children will notice that the numbers 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, and 26 can be made into two trains of equal length with no remainders. They will recognize these numbers as even numbers and perhaps supply their own definition of even numbers as "the doubles" or "numbers that make equal trains with no leftovers when you roll a 2."

When they look at the numbers that have 3 as a divisor and no remainder —namely, 3, 6, 9, 12, 15, 18, 21, 24, and 27—children will be reminded of the multiplication table for 3. They may notice that this list includes every third number from the list of even numbers and has an odd-even pattern.

Extending the Activity

Have children play the game with one of these variations:

- Use an 8-sided or 10-sided die.
- Use a standard die labeled with larger numbers.
- Start with a different number of Snap Cubes.

Four is a divisor for 4, 8, 12, 16, 20, and 24. These numbers are made up of every other number from the even list. As the size of the divisor increases, the list of numbers shortens. By the time children get to the numbers that have 5 as a divisor, there are only five: 5, 10, 15, 20, and 25. The list for 6 is even shorter with only 4 numbers: 6, 12, 18, and 24.

Children are apt to report that 12 and 24 are the numbers they got "stuck on" in the game. By this, they mean that any roll of the die, except 5, resulted in trains with an equal number of cars and no leftover cabooses; so play went back and forth between the two players with no one winning any loose caboose cubes until a 5 was rolled.

When the children look for numbers that always give loose caboose cubes (unless a 1 was rolled), they will find 7, 11, 13, 17, 19, and 23. Later, children will learn that these numbers are part of the set called prime numbers, which have exactly two divisors: the number itself and 1. The prime numbers 2, 3, and 5 would not belong on the children's list because these numbers have no leftovers when the numbers themselves (2, 3, or 5) are rolled.

By a lucky roll of the die or if the children have played the game enough to be able to compile exhaustive lists of data, they will see that the numbers 11, 17, and 23 hold the potential for rolling a 6 on the die and netting the largest number (5) of loose caboose cubes possible for this game.

In analyzing the parts of their division problems — namely, the dividend, divisor, quotient, and remainder — children get their first taste of the study of number theory and a foundation for dealing with division in an algebraic context.
