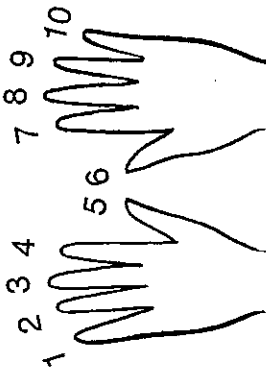


## Your Fingers as a Calculator

Rasha showed her father the “casting out nines” trick. That reminded him of a trick he learned when he was a boy. He said, “I’ll show you how to multiply by nine using your fingers. No paper or pencil, no calculator.”

“Let’s see you multiply 9 times 364 on your fingers,” challenged Rasha.

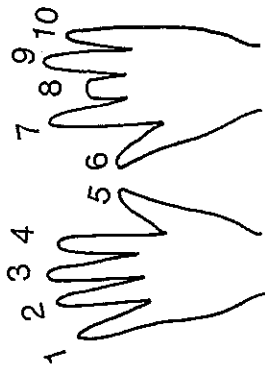
“I can’t do that. It only works for multiplication with any number 2 to 10. Here’s what you do.”



He held up his fingers. “Number your fingers from 1 to 10. Suppose you want to multiply 9 times 4. Bend the fourth finger. Now count the fingers to the left of the bent finger—

3. There are 6 fingers to the right of the bent finger. The answer is 36. Now you try it.”

Rasha used her fingers to multiply  $9 \times 8$ .



She counted 7 fingers to the left of the bent finger and 2 to the right. The answer: 72.

### Try This

Use your fingers as a calculator to multiply nine times any number from 2 through 10. Figure out why it works.

## Casting Out Nines

While Rasha and Lisa were looking for information about divisibility tests, they came upon the trick called “Casting Out Nines.” This is a way of checking your work in addition, subtraction, and multiplication. The Arabs were using it more than a thousand years ago.

The girls tried it out with each operation. Here are the examples they used. For each number, they found the sum of the digits. If the sum of digits is greater than 9, add the digits in this sum, until the final sum is a one-digit number, called the *digital* of the number.

Addition:	Numbers	Digital
	892 → 19 → 10 → 1	
	25 → 7	
	+179 → 17 → 8	
	1,096 → 16 → 7	

The digital of the sum is 7 in both columns. It seems that the addition is correct.

To check subtraction, subtract the digitals. To check multiplication, multiply the digitals.

(Caution: Sometimes this method doesn't work.) Lisa added like this:

$$258 + 479 = 647$$

The “casting out nines” test worked, so the answer seemed correct. Both sums had the digital 8. But when Rasha looked at the addition, she saw that it was incorrect.

“The correct sum is 737,” she told Lisa. The girls wondered what went wrong.

### Try This

Use “casting out nines” to test several calculations. Try it with addition, with subtraction, and with multiplication.

### Think About This

Figure out why the test did not work for Lisa's addition.

