Objective To extend the U.S. traditional long division algorithm for single-digit divisors to four- and five-digit dividends and dividends in dollars-and-cents notation.

Doing the Project

Recommended Use: After Lesson 9-9 and after Project 11.

Key Activities
Students explore and practice the U.S. traditional long division algorithm for single-digit divisors to four- and five-digit dividends and dividends in dollars-and-cents notation.

Key Concepts and Skills
• Subtract multidigit numbers
  [Operations and Computation Goal 2]
• Apply multiplication facts to long-division situations.
  [Operations and Computation Goal 3]
• Solve equal-sharing division problems and number stories.
  [Operations and Computation Goal 4]
• Divide decimals by whole numbers.
  [Operations and Computation Goal 4]

Key Vocabulary
long division • quotient • dividend

Extending the Project

Students write division number stories and use the U.S. traditional long division algorithm to solve them.

Technology
See the ITLG and iSRB.

Additional Information
Today there are no longer any bills larger than $100 in circulation, but it was not always so. Beginning in the late 1920s and early 1930s the U.S. Treasury issued a small number of large bills, including $500, $1,000, $5,000, $10,000, and $100,000 bills. By the mid-1940s, the Treasury stopped making these bills, and in 1969 President Nixon removed them from circulation because they were rarely used and attractive to counterfeiters.

Advance Preparation If you intend to have students use coins and bills to model the division problems, you will need $100 and $1,000 bills. Make several copies of Third Grade Math Masters, page 401 for the $100 bills or use index cards to create them. Use index cards to create $1,000 bills.

materials
- Math Journal, pp. 15–17
- Student Reference Book, pp. 24E–24H and 40D–40F
- $1 and $10 bills (Math Masters, p. 428; optional)
- $100 bills (optional)
- coins (optional)
- base-10 blocks (optional)
- index cards (optional)

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1 Doing the Project

Solving a Division Problem

(Math Journal, p. 15)

Ask students to solve Problem 1 on journal page 15. Tell them they may use paper and pencil or any tools they wish, except calculators.

Have students discuss and share solutions. Expect a variety of approaches, including the U.S. traditional long division method, which was introduced in Project 11. Have students explain why each of the steps in their procedures make sense.

For example:

Sharing play money or base-10 blocks

Using an informal paper-and-pencil method

\[
\begin{align*}
4353 - 3000 & \quad \text{\$1000 for each player} \\
1353 - 300 & \quad \text{\$100 for each player} \\
753 - 300 & \quad \text{\$100 for each player} \\
453 - 300 & \quad \text{\$100 for each player} \\
153 - 150 & \quad \text{\$50 for each player} \\
3 - 3 & \quad \text{\$1 for each player} \\
0 &
\end{align*}
\]

\$1000 + \$100 + \$100 + \$100 + \$50 + \$1 = \$1451

Using the partial-quotients algorithm

\[
\begin{align*}
3!4353 & \\
- 3000 & \quad \text{\$1000} \\
1353 - 1200 & \quad \text{\$400} \\
153 - 150 & \quad \text{\$50} \\
3 - 3 & \quad \text{\$3} \\
0 & \quad \text{\$1451}
\end{align*}
\]

Using the U.S. traditional long division algorithm

\[
\begin{align*}
1451 \div 3 & \\
3!4353 & \\
- 3 & \quad \text{13} \\
12 & \quad \text{15} \\
15 - 15 & \quad \text{02} \\
3 & \quad \text{0}
\end{align*}
\]
Extending Long Division to Larger Dividends

After you have discussed students’ solutions, regardless of whether some students used the U.S. traditional long division algorithm, demonstrate the problem again as described below. Illustrate each step in the algorithm with pictures of play money. Help students make connections between the steps in the algorithm and the actions of sharing money.

**Step 1:**
Set up the problem. Think about sharing actual bills: 4 [$1,000]s, 3 [$100]s, 5 [$10]s, and 3 [$1]s. *(See margin.)*

Long Division:

$$3 \underline{)4353}$$

$4,353$ is to be shared.

Three players will share Jen’s money.

**Step 2:**
Share the [$1,000]s. Each player gets 1 [$1,000]. There is 1 [$1,000] left. *(See margin.)*

Long Division:

$$1 \underline{)3100}$$

1 [$1,000] each for 3 players = 3 [$1,000]s.

**Step 3:**
Trade the 1 [$1,000] for 10 [$100]s. *(See margin.)*

Long Division:

$$1 \underline{)313}$$

10 [$100]s from the 1 [$1,000] + 3 [$100]s = 13 [$100]s.
Step 4:
Share the 13 [$100]s. Each player gets 4 [$100]s; 1 [$100] is left.  
(See margin.)

\[
\begin{array}{c}
1 & 4 \\
3 & 4 & 3 & 5 & 3 \\
-3 & 1 & 3 \\
-1 & 2 \\
1 & 5
\end{array}
\]

Each player gets 4 [$100]s.

4 [$100]s each for 3 players = 12 [$100]s.

1 [$100] is left.

Step 5:
Trade the 1 [$100] for 10 [$10]s. (See margin.)

\[
\begin{array}{c}
1 & 4 \\
3 & 4 & 3 & 5 & 3 \\
-3 & 1 & 3 \\
-1 & 2 \\
1 & 5
\end{array}
\]


Step 6:
Share the 15 [$10]s. Each player gets 5 [$10]s. (See margin.)

\[
\begin{array}{c}
1 & 4 & 5 \\
3 & 4 & 3 & 5 & 3 \\
-3 & 1 & 3 \\
-1 & 2 \\
1 & 5 \\
-1 & 5 \\
0
\end{array}
\]


0 [$10]s are left.

Step 7:
Share the 3 [$1]s. Each player gets 1 [$1]. (See margin.)

\[
\begin{array}{c}
1 & 4 & 5 & 1 \\
3 & 4 & 3 & 5 & 3 \\
-3 & 1 & 3 \\
-1 & 2 \\
1 & 5 \\
-1 & 5 \\
0 & 3
\end{array}
\]

3 [$1]s are to be shared.


0 [$1]s are left to be shared.

$4,353 / 3 = $1,451. Each of the continuing players gets $1,451.
Solving Long Division Problems

(Math Journal, pp. 15 and 16; Student Reference Book, pp. 24E–24H)

Have partners use the U.S. traditional long division algorithm to solve the problems on journal pages 15 and 16. Students may find the examples on Student Reference Book, pages 24E–24H helpful.

Extending Long Division to Dollars-and-Cents Notation

(Math Journal, p. 17; Student Reference Book, pp. 40D–40F)

Have students solve Problems 1 and 2 on journal page 17. As a class, discuss how Dennis solved the problem. Be sure to include the following points:

- The long division algorithm for dollars and cents looks almost exactly the same as for whole numbers.
- The money in Dennis’s method would include dimes and pennies, not just bills as in whole-number long division with money.
- There are decimal points separating dollars from cents in Dennis’s quotient and dividend. In whole-number long division there were no decimal points.
- With Dennis’s method, we know exactly where the decimal point belongs. If we use partial quotients division to solve the problem, we use estimation to place the decimal point. For example, to solve $9.45 / 7$ by partial quotients:
  - Estimate the answer. $9.45 / 7$ would be more than $1$ but less than $2$.
  - Divide as though the dividend were a whole number. $945 / 7 = 135$
  - Use the estimate to place the decimal point in the quotient. Since the answer must be between $1$ and $2$, the decimal point must go between the 1 and the 3; $1.35$.

Pose additional problems such as the following. Review Student Reference Book, pages 40D–40F as necessary.

- $1.72 / 4 = 0.43$
- $7.05 / 5 = 1.41$
- $9.27 / 3 = 3.09$
- $9.42 / 6 = 1.57$
## Extending the Project

### Writing and Solving Division Number Stories

*(Student Reference Book, pp. 24E–24H and 40D–40F)*

Have students write division number stories that include single-digit divisors, four- and five-digit dividends, and dividends in dollars-and-cents notation. Partners use the U.S. traditional long division algorithm to solve them. Students may find the examples on *Student Reference Book*, pages 24E–24H and 40D–40F helpful.