Lesson 13: Dividing Multi-Digit Numbers Using the Algorithm

Student Outcomes

- Students understand that the standard algorithm of division is simply a tally system arranged in place value columns.

Classwork

Example 1 (6 minutes)

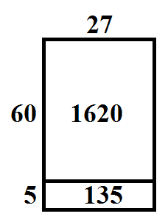
The first example is a review from Lesson 12 that will prepare students to start taking a deeper look at the division algorithm.

MP.6 & MP.8

Example 1

a. **Create a model to divide: $1,755 \div 27$.**

Answers may vary. One possible solution:



b. **Use the division algorithm to show $1,755 \div 27$.**

$$\begin{array}{r} 65 \\ 27\overline{)\,1755} \\ \underline{-162} \\ 135 \\ \underline{-135} \\ 0 \end{array}$$

- Looking at your division work, where did the numbers 162 and 135 come from?

$$\begin{array}{r} 65 \\ 27\overline{)\,1755} \\ \underline{-162} \\ 135 \\ \underline{-135} \\ 0 \end{array}$$

  - *The* 162 *comes from* 27×6. *This is really showing* 27×60, *which is* $1{,}620$. *The* 135 *comes from* 27×5.

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- If you had to describe what is happening underneath the division bar in your own words, what would you say? (For struggling students, have them think back to what they did when they used a model.)
  - *The work under the long division bar shows how I keep track of the parts that I have already divided out. Then, I can see what remains to continue the process.*

> **c. Check your work.**
>
> $27 \times 65 = 1,755$

Scaffolding:

For classes that need more practice, use the following examples:

$7{,}182 \div 21 = 342$

$2{,}312 \div 34 = 68$

Example 2 (6 minutes)

> **Example 2**
>
> **Find the quotient of** $205,276 \div 38$.
>
> 5402
> 38) 205276
> \- 190
> 152
> \- 152
> 076
> \- 76
> 0

MP.6 & MP.8

- How can we use estimation to start solving this problem?
  - *Answers will vary. I can start by determining how many times* 40 *will divide into* 200 *thousands. I know that* $40 \times 5 = 200$. *So, I will start the division process by placing a* 5 *over the* 5 *in* $205{,}276$. *This* 5 *represents* 5 *thousands. So, we will show in the long division that* 200 *thousands* $\div 38 =$ 5 *thousands.*
- Why did you divide 40 into 200 instead of $200{,}000$?
  - *I thought of this problem as* 40 *into* 200 *thousands so that I could divide* 40 *into* 200 *to make the division simpler.*

Give students a chance to complete the division. Students should also be creating a model to show the connection between the algorithm and the model.

5402
38) 205276
\- 190
152
\- 152
076
\- 76
0

	38
5000	190,000
400	15,200
2	76

- After you divided by 400, what did you do next?
  - *I had brought down the seven to complete the next step. However,* 38 *does not divide into* 7 *one or more times. This told me to put a* 0 *in the tens place and bring down the* 6 *to continue dividing.*

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- Imagine that your friend wrote 542 as the answer. How could you prove to your friends that 542 is not the solution?
  - *Answers may vary. I could use estimation. I would round the divisor and quotient and multiply them to see if I get an estimate that is close to the dividend,* $40 \times 500 = 20{,}000$. *The estimate is about* 10 *times too small. So, I can tell that the numbers are in the wrong place. I should have an estimate around* $200{,}000$.

Now, let's use the algorithm to work through a division question that involves a much larger number.

Example 3 (6 minutes)

Example 3

Find the quotient of $17{,}216{,}673 \div 23$.

MP.6 & MP.8

- When working with a dividend as large as this, what would happen if we tried to solve this question using a model?
  - *Answers will vary. The model would be difficult to make because it could have many parts for the different place values.*
- It might be difficult to figure out how many times 23 goes in to this whole number. So, we can break this into parts. Does 23 go into 1 one or more times? Does 23 go into 17 one or more times? Will 23 divide into 172 one or more times?
  - 23 *does not go into* 1 *or* 17 *one or more times. However,* 23 *will go into* 172 *one or more times.*
- Could we use estimation to help us start the problem?
  - *We could think about* $175 \div 25$ *or* $180 \div 20$ *(or other possible estimations that are backed by mathematical reasoning).*

$$\begin{array}{r|l} & \;\;7 \\ \hline 23 & 17216673 \\ & \underline{-161} \\ & \;\;\;11 \end{array}$$

Remind students that what we are actually doing is 172 hundred thousands $\div\, 23 = 7$ hundred thousands.

Each step can be represented using the units.

- Why would we place the 7 over the 2 and not somewhere else? What does the 7 represent?
  - *The* 7 *shows how many times* 23 *goes into* 172*, but it really represents how many times* 23 *goes into* $17{,}200{,}000$. *Because the* 7 *represents* $700{,}000$*, we place the* 7 *over the* 2 *in the hundred thousands place.*
- When we subtracted, we got an 11. What does this 11 represent?
  - *The* 11 *shows the difference between* 172 *and* 161*, but it actually represents* $1{,}100{,}000$. *This is the amount remaining after* 23 *groups of* $700{,}000$ *are taken from* $17{,}200{,}000$.

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MP.6 & MP.8

- After we have completed this first set of steps, where do we go next?
  - *We could keep repeating the process until we reach the ones place.*

$$\begin{array}{r} 748551 \\ 23\,\overline{)\,17216673} \\ \underline{-161} \\ 111 \\ \underline{-92} \\ 196 \\ \underline{-184} \\ 126 \\ \underline{-115} \\ 117 \\ \underline{-115} \\ 23 \\ \underline{-23} \\ 0 \end{array}$$

When discussing the remaining steps, you can refer to them as follows:

111 ten thousands $\div$ 23: 4 ten thousands

196 thousands $\div$ 23: 8 thousands

126 hundreds $\div$ 23: 5 hundreds

117 tens $\div$ 23: 5 tens

23 ones $\div 23 = 1$

- How can we determine if the answer is reasonable?
  - *We could multiply the quotient with the divisor.* $748{,}551 \times 23 = 17{,}216{,}673$.
  - *We could also use an estimate to check our work.* $20{,}000{,}000 \div 20 = 1{,}000{,}000$. *Our estimate is slightly larger because we rounded the dividend up.*

Exercises 1–6 (20 minutes)

Give students a chance to practice using the division algorithm. Students may not be able to complete all questions in the time given.

Exercises 1–6

For each question, you need to do the following:

a. Solve the question. Next to each line, explain your work using place value.

b. Evaluate the reasonableness of your answer.

1. $891{,}156 \div 12$

$$\begin{array}{r} 74263 \\ 12\,\overline{)\,891156} \\ \underline{-84} \\ 51 \\ \underline{-48} \\ 31 \\ \underline{-24} \\ 75 \\ \underline{-72} \\ 36 \\ \underline{-36} \\ 0 \end{array}$$

a. 89 *ten thousands* $\div 12$: 7 *ten thousands*
51 *thousands* $\div 12$: 4 *thousands*
31 *hundreds* $\div 12$: 2 *hundreds*
75 *tens* $\div 12$: 6 *tens*
36 *ones* $\div 12$: 3 *ones*

b. $74{,}263 \times 12 = 891{,}156$

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2. $484,692 \div 78$

$$\begin{array}{r}
6214 \\
78\overline{)484692} \\
\underline{-468} \\
166 \\
\underline{-156} \\
109 \\
\underline{-78} \\
312 \\
\underline{-312} \\
0
\end{array}$$

a. *484 thousands* $\div$ 78: *6 thousands*
166 hundreds $\div$ 78: *2 hundreds*
109 tens $\div$ 78: *1 ten*
312 ones $\div$ 78: *4 ones*

b. $6,214 \times 78 = 484,692$

3. $281,886 \div 33$

$$\begin{array}{r}
8542 \\
33\overline{)281886} \\
\underline{-264} \\
178 \\
\underline{-165} \\
138 \\
\underline{-132} \\
66 \\
\underline{-66} \\
0
\end{array}$$

a. *281 thousands* $\div$ 33: *8 thousands*
178 hundreds $\div$ 33: *5 hundreds*
138 tens $\div$ 33: *4 tens*
66 ones $\div$ 33: *2 ones*

b. $8,542 \times 33 = 281,886$

4. $2,295,517 \div 37$

$$\begin{array}{r}
62041 \\
37\overline{)2295517} \\
\underline{-222} \\
75 \\
\underline{-74} \\
151 \\
\underline{-148} \\
37 \\
\underline{-37} \\
0
\end{array}$$

a. *229 ten thousands* $\div$ 37: *6 ten thousands*
75 thousands $\div$ 37: *2 thousands*
15 hundreds $\div$ 37: *0 hundreds*
151 tens $\div$ 37: *4 tens*
37 ones $\div$ 37: *1 one*

b. $62,041 \times 37 = 2,295,517$

5. $952,448 \div 11$

$$\begin{array}{r}
8504 \\
112\overline{)952448} \\
\underline{-896} \\
564 \\
\underline{-560} \\
448 \\
\underline{-448} \\
0
\end{array}$$

a. *952 thousands* $\div$ 112: *8 thousands*
564 hundreds $\div$ 112: *5 hundreds*
44 tens $\div$ 112: *0 tens*
448 ones $\div$ 112: *4 ones*

b. $8,504 \times 112 = 952,448$

6. $1,823,535 \div 245$

$$\begin{array}{r}
7443 \\
245\overline{)1823535} \\
\underline{-1715} \\
1085 \\
\underline{-980} \\
1053 \\
\underline{-980} \\
735 \\
\underline{-735} \\
0
\end{array}$$

a. *1,823 thousands* $\div$ 245: *7 thousands*
1,085 hundreds $\div$ 245: *4 hundreds*
1,053 tens $\div$ 245: *4 tens*
735 ones $\div$ 245: *3 ones*

b. $7,443 \times 245 = 1,823,535$

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Closing (3 minutes)

- Explain in your own words how the division algorithm works.
  - *Answers will vary. Sample response: The division algorithm shows successive estimates of the quotient organized by place value, or the division algorithm breaks one large division problem into several smaller ones organized by place value.*

Exit Ticket (4 minutes)

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Name ____ Date____________________

Lesson 13: Dividing Multi-Digit Numbers Using the Algorithm

Exit Ticket

Divide using the division algorithm: $392{,}196 \div 87$.

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Exit Ticket Sample Solutions

Divide using the division algorithm: $392,196 \div 87$.

```
       4508
87 ) 392196
    -348
      441
     -435
       696
      -696
         0
```

Problem Set Sample Solutions

1. $459,054 \div 54$

```
       8501
54 ) 459054
     -432
       270
     - 270
        054
      -  54
          0
```

2. $820,386 \div 102$

```
        8043
102 ) 820386
      -816
        438
       -408
         306
       - 306
           0
```

3. $1,183,578 \div 227$

```
         5214
227 ) 1183578
     -1135
        485
       -454
        317
      -  227
          908
       -  908
            0
```


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