Lesson: Multiplication using the partial-products algorithm
Math Academy – Day 04
Student Notes

Goals:
- Recognize area as additive.
- Develop the partial-products method for multiplying multi-digit natural numbers.

Prerequisite Knowledge:
- Know multiplication tables up to 9×9.
- Know multiplication by a power of ten.

Activities:

1. Teacher-Led Class Discussion: $12 \cdot 13$ using base-ten blocks and how it relates to the partial-products method for multiplication.

2. Working with your partner, you are tasked with replicating what you just observed and noted. Given the problem 17×11, show the multiplication using base-ten blocks. Draw your findings below. Also, do the problem using the partial products paper-and-pencil method for 17×11. Highlight the rectangular regions in the drawing to the rectangular regions in the partial products algorithm. Be prepared to share your findings with the class.

3. Working with your partner, sketch the multiplication problem: 126×59. Also, work out the problem using the partial products paper-and-pencil method. Highlight the rectangular regions in the drawing to the rectangular regions in the partial products algorithm. Be prepared to share your findings with the class.

4. Working with your partner, work out the multiplication problem 2005×11 using the partial products paper-and-pencil method. Be prepared to share your thoughts with the class.

Lesson: Multiplication using the partial-products algorithm
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Instructor Notes

Goals:
- Recognize area as additive.
- Develop the partial-products method for multiplying multi-digit natural numbers.

Prerequisite Knowledge:
- Know multiplication tables up to 9×9.
- Know multiplication by a power of ten.


Lesson Materials:
- None

Preparation:
- None

Lesson Breakdown:

Activity	Size of Group	Time in Activity Total Time: 55 minutes
Present partial products using 2-digit natural numbers	Whole class	20 minutes
Students model partial products using 2-digit natural numbers	Groups of 2	10 minutes
Present partial products using 2-digit and 3-digit natural numbers	Groups of 2	15 minutes
Present partial products using 2-digit and 4-digit natural numbers	Groups of 2	10 minutes

Activities:

5. Teacher-Led Class Discussion: 12 · 13 using base-ten blocks and how it relates to the partial-products method for multiplication.

Students should have four regions
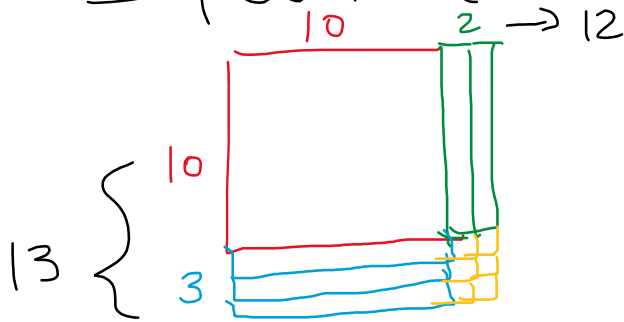
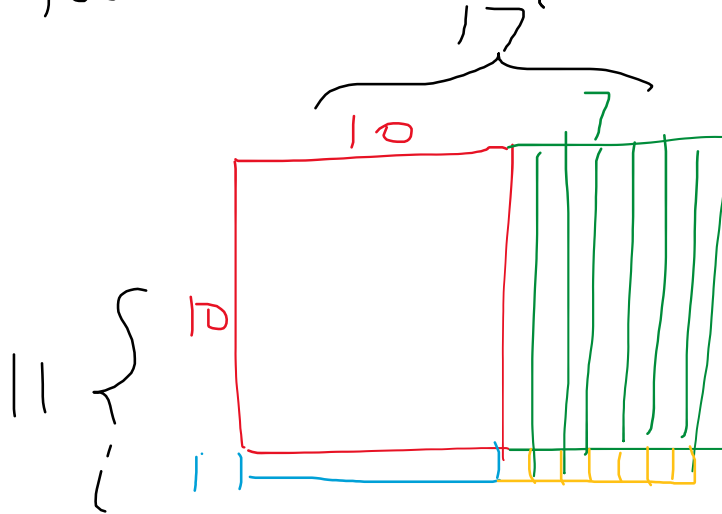Suggest students to walk through how to compute the paper-and-pencil

$$\begin{array}{r} 13 \\ \times\ 12 \\ \hline 6 \\ 20 \\ 30 \\ +\ 100 \\ \hline 156 \end{array}$$

First 2×3

2×10

10×3

10×10

SIDE NOTE:
USE proper place value names. For ex.
Not $2 \times 1 \rightarrow$
it is 2×10.

<u>Note</u>: This helps students understand the distributive property that is heavily used in algebra.
It gets them to see that they have always been doing it.

6. Working with your partner, you are tasked with replicating what you just observed and noted. Given the problem 17 × 11, show the multiplication using base-ten blocks. Draw your findings below. Also, do the problem using the partial products paper-and-pencil method for 17 × 11. Highlight the rectangular regions in the drawing to the rectangular regions in the partial products algorithm. Be prepared to share your findings with the class.

Now. they should try this without too much help —

$$
\begin{array}{r}
17 \\
\times\ 11 \\
\hline
7 \\
10 \\
70 \\
+\ 100 \\
\hline
187
\end{array}
\qquad
\begin{array}{l}
1 \times 7 \\
1 \times 10 \\
10 \times 7 \\
10 \times 10
\end{array}
$$

7. Working with your partner, sketch the multiplication problem: 126 × 59. Also, work out the problem using the partial products paper-and-pencil method. Highlight the rectangular regions in the drawing to the rectangular regions in the partial products algorithm. Be prepared to share your findings with the class.
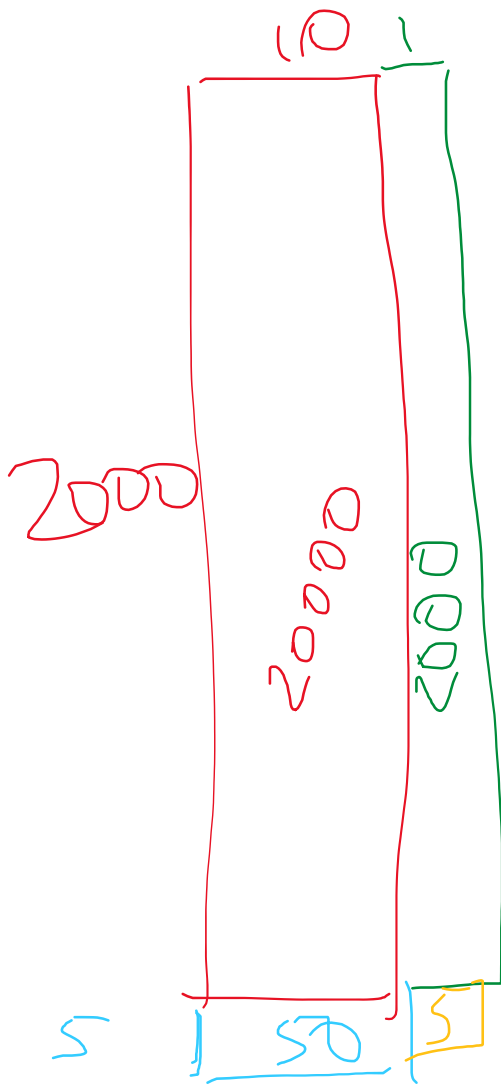
Sketch used here.

$$\begin{array}{r} 126 \\ \times\ 59 \\ \hline 154 \\ 180 \\ 900 \\ 1\,300 \\ +\ 1000 \\ 5000 \\ \hline 7434 \end{array}$$

9×6
9×20
9×100
50×6
50×20
50×100

8. Working with your partner, work out the multiplication problem 2005 × 11 using the partial products paper-and-pencil method. Be prepared to share your thoughts with the class.

$$2005$$
$$\times \quad 11$$

$$5 \qquad 1 \times 5$$
$$2000 \qquad 1 \times 2000$$
$$50 \qquad 10 \times 5$$
$$+ \quad 20000 \qquad 10 \times 2000$$
$$\overline{22055}$$

Result: 22055

1. Write a story problem that represents 16x19.

    a. Sketch a picture of this multiplication using area models of the base-ten blocks.

    b. Do the pencil-and-paper method to find the result.

    c. Relate the areas in the sketch to the areas in the pencil-and-paper method.

2. Write a story problem that represents 278x304.

      d. Sketch a picture of this multiplication using area model of the base-ten blocks.

      e. Do the pencil-and-paper method to find the result.

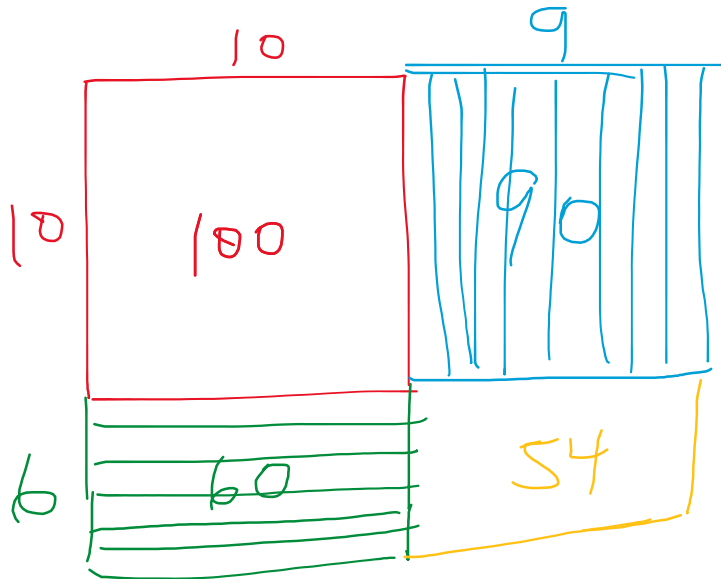   f. Relate the areas in the sketch to the areas in the pencil-and-paper method.

3. What is the solution to the following? $120 - 72 \div 6 \times 4$

    A.   117
    B.   32
    C.   2
    D.   72

HOMEWORK SOLUTIONS:

1. Write a story problem that represents 16x19.

    a. Sketch a picture of this multiplication using area models of the base-ten blocks.

    b. Do the pencil-and-paper method to find the result.

$$\begin{array}{r} 19 \\ \times\ 16 \\ \hline 54 \quad 6\times9 \\ 60 \quad 6\times10 \\ 2\ 90 \quad 10\times9 \\ +\ 100 \quad 10\times10 \\ \hline 304 \end{array}$$
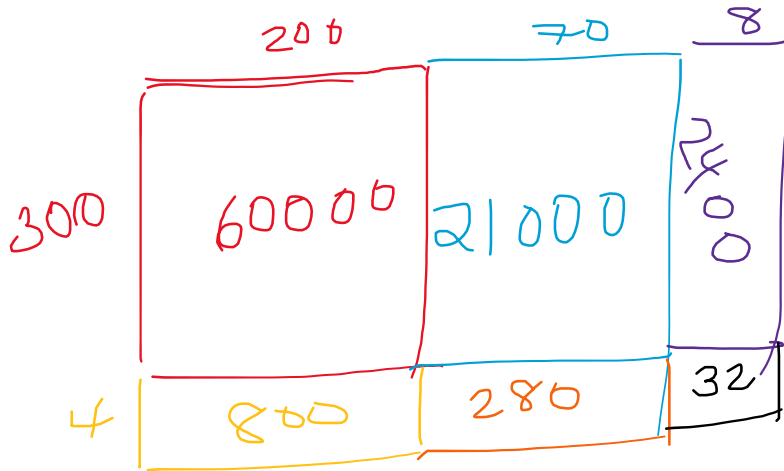
    c. Relate the areas in the sketch to the areas in the pencil-and-paper method.

    The relationship is shown using the colors above.

2. Write a story problem that represents 278x304.

   a. Sketch a picture of this multiplication using area model of the base-ten blocks.

	20 0	70	8
300	60000	21000	2400
4	800	280	32

   b. Do the pencil-and-paper method to find the result.

$$
\begin{array}{r}
304 \\
\times\ 278 \\
\hline
\end{array}
$$

1 32	8 × 4
2 400	8 × 300
280	70 × 4
21 000	70 × 300
800	200 × 4
+ 6 0000	200 × 300

84512

   c. Relate the areas in the sketch to the areas in the pencil-and-paper method.

      The relationship is shown using the colors above.

3.　　$120 - 72 \div 6 \times 4$ - division first
　　　　$120 - 12 \times 4$- multiplication second
　　　　$120 - 48$- subtraction third
　　　　$72 = D$

INCORRECT SOLUTIONS

$120 - 72 \div 6 \times 4$- multiplication first
$120 - 72 \div 24$- division second
$120 - 3$- subtraction third
$117 = A$

$120 - 72 \div 6 \times 4$- subtraction first
$48 \div 6 \times 4$- division second
8×4- multiplication third
$32 = B$

$120 - 72 \div 6 \times 4$-subtraction first
$48 \div 6 \times 4$- multiplication second
$48 \div 24$- division third
$2 = C$