Title: Multiplication Magic

Brief Overview:

Students will develop an understanding of how to multiply by two-digit numbers. They will build their understanding by exploring a variety of methods to solve problems. They will use manipulatives and decompose numbers to aid in their understanding of the traditional algorithm. Through these techniques, the students will realize that in order to develop a true understanding of multiplication, they will need to grasp the concepts of place value and regrouping. The product of a multiplication problem is not the result of "magic".

NCTM Content Standard:

Number and Operations
Reasoning
Communication

Grade/Level: 4-5

Duration/Length:

4 days for 50-60 minutes daily
The summative assessment will be completed on the fourth day.

Student Outcomes:

Students will:

- Demonstrate their understanding of multiplication of two-digit numbers by using manipulatives, decomposing numbers, and traditional algorithms.
- Demonstrate their understanding of place value.
- Demonstrate their understanding of regrouping.

Materials and Resources:

Lesson 1

- Chart paper
- Markers
- Counters
- Base Ten Blocks/Overhead Base Ten Blocks
- Sample Problems (Teacher Resource Sheet 1)
- *Observation Checklist* (Teacher Resource Sheet 2)

Lesson 2

- Double Number Cubes (1 per each pair of students)
- *Merlin's Multiplication War* (Student Resource Sheet 1)
- *Merlin's Multiplication War* (Student Resource Sheet 2) –Cut cards prior to the game.
- *Merlin's Multiplication Grid* (Student Resource Sheets # 3 and 4)
- *Observation Checklist* (Teacher Resource Sheet 2)

Lesson 3

- *Merlin's Magnificent Bingo* (Student Resource Sheets # 5, 5A and 6)
- *EMAC Resource Sheet* (2 - Student Resource Sheet 7 and Teacher Resource Sheet 3)
- *Base Ten Blocks Patterns* – 2 sheets per student (Student Resource Sheet 9)
- *Observation Checklist* (Teacher Resource Sheet 2)
- Calculators
- *Algorithm Extra Practice* (Student Resource Sheet 8)
- *Algorithm Extra Practice* (Teacher Resource Sheet 4)

Development/Procedures:

Lesson 1.....

Preassessment/Launch –

- Show the students the following scenario on the chalkboard or chart paper:

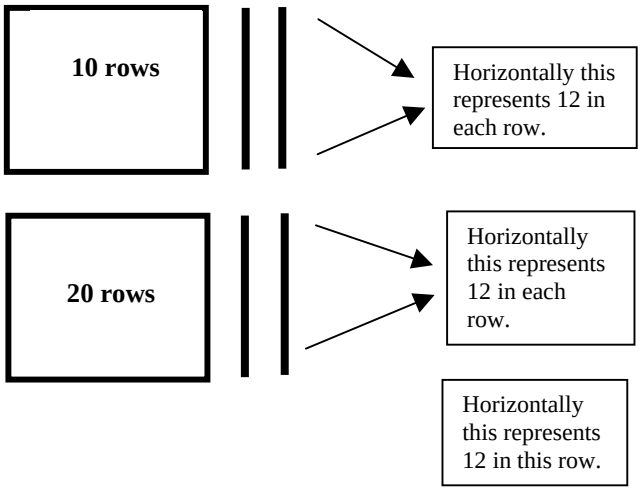
  At the Prettyboy School of Magic, 21 students are learning to pull handkerchiefs out of hats. To the children's surprise, 12 handkerchiefs appeared out of each of their hats. How many handkerchiefs did the class have all together?

- Divide the students into small groups. Assign each group one of the following methods:
  - Group 1 - Chart paper and pencil
  - Group 2 – Base Ten Blocks
  - Group 3 - Chart paper and markers to model pictures
  - Group 4 - Counters

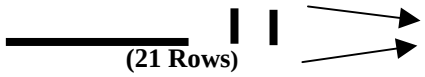
  The students will work together to use their assigned method to solve the problem from the above scenario.

Teacher Facilitation –

- The students will meet together as an entire group to discuss their methods and answers to the problem. Encourage the students to discuss the pros and cons of their method.
- Discuss the meaning of multiplication (*Repeatedly adding groups of numbers)*
- Using overhead Base Ten Blocks, model how to solve the problem. (*The students need to show 21 groups of 12*)



This diagram shows 21 rows with 12 in each row. One flat is equivalent to 10 rows and 10 groups. The rods and unit cubes add 2 more to each row making each row equal to12. To solve the problem, count the ones first, regroup if necessary. Then, count the tens, regroup if necessary. Finally, count the hundreds, regroup if necessary.



- Work with the students to use Base Ten Blocks to model other problems. (Teacher Resource Sheet 1)

Student Application –

- The students will work together using Base Ten Blocks to solve the following problems:
  - *43 x 21 (903)*
  - *32 x 17 (544)*
  - *63 x 14 (882)*

Embedded Assessment –

- While the students are multiplying using the Base Ten Blocks, observe and record behaviors on the *Observation Checklist* (Teacher Resource Sheet 2). Discuss with the students that their performance will be assessed as they work with the manipulatives. Establish with the students the criteria that will be observed. Evaluation
  - ✓ + = **Independent Understanding**
  - ✓ = **Some Assistance Needed**
  - ✓ - = **Total Assistance Needed**

Reteaching –

- Work with students in small groups who demonstrated difficulty with the concepts of regrouping and place value using the manipulatives.

Enrichment –

- Students who demonstrated their understanding of place value and regrouping should continue working together to create and model their own multiplication problems using Base Ten Blocks.

Lesson 2

Preassessment –

- Have the students respond to the following journal prompt:
  When do you multiply by 2-digit numbers in real life?

Launch –

- The students will participate in the game *Merlin's Multiplication War* (Student Resource Sheets # 1 and 2) in order to use mental math to multiply multiples of ten. Discuss the results of the game with the students. Share answers to some of the problems the students solved in the game.

Teacher Facilitation –

- Inform the students that they will be multiplying by multiples of ten in order to solve multiplication problems by decomposing numbers.
- Discuss with the students the meaning of the word **decomposition.** (*Breaking something down, taking something apart, etc.*…)
- Ask: How do you think we will be taking apart a multiplication problem? Have the students brainstorm their ideas.
- Show the following multiplication problem to the students:

  45
  x 16
- Discuss with the students how this multiplication problem could be "broken down" by multiplying the value of each digit. (*Decomposing Numbers)*

1. **Multiply the ones place in both factors.** *(5 x 6 = 30)*
2. **Multiply the tens place in the first factor by the ones place in the second factor.** *(40 x 6 = 240)*
3. **Multiply the tens place in the second factor by the ones place in the first factor.** *(10 x 5 = 50)*
4. **Multiply the tens place in both factors.** ***(****40 x 10 = 400)*
5. **Add all of the products together.**

45
X 16
30 (5x6)
240 (40x6)
50 (10x5)
+ 400 (40x10)
720

- Continue to work with the students to model and solve the following problems by decomposing numbers using multiplication.
  - 36 x 23 *(828)*
  - 54 x 34 *(1,836*)
  - 78 x 12 *(936)*

Student Application –

- Model for the students how to play the game *Merlin's Multiplication Grid* (Student Resource Sheets # 3 and 4)
- In this game, small groups of students will role a double number cube to form 2- two digit numbers. They will multiply the numbers they formed by decomposing the numbers.

Embedded Assessment –

- Observe the students' ability to decompose numbers using multiplication. Focus on their ability to use place value as well as their knowledge of basic facts. Make notes of these observations on the *Observation Checklist* (Teacher Resource Sheet 2). Focus on the first two sets of criteria.

Reteaching –

- Meet with small groups of students who struggled with decomposing numbers using multiplication while playing the game. Replay the game together in order to review the steps for decomposing numbers.

Extension –

- The students who demonstrated an understanding of decomposing numbers using multiplication may replay the game. For an extra challenge, the students may roll for a three-digit number in order to multiply that number by a two-digit number.

Lesson 3

Preassessment –

- Have the students respond to the following journal prompt:
  - *Why is estimating important to solving multiplication problems?*
- Share answers.
- Review with the students how to estimate multiplication problems.

Launch –

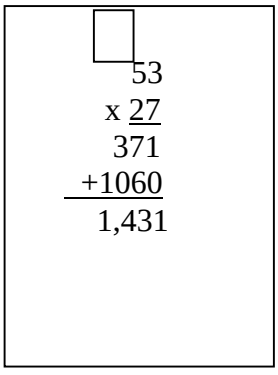
- Review with the students the two methods of solving multiplication problems previously learned. *(Base Ten Blocks and Decomposing Numbers Using Multiplication)*
- The students should select one of these methods to solve the problems in the game *Merlin's Magnificent Bingo* (Student Resource Sheets # 5 and 6). For this game, the students must pick two factors to multiply together. Then, they must find the product on the game board. They will need to find a strategy that will help them find products that will go four in a row.
- Have the students share their answers and methods they used to solve the problems in the game.

Teacher Facilitation –

- Introduce the third method the students will be learning to multiply numbers, the Algorithm.
- Model how to multiply numbers using the traditional algorithm:

Example:

1. **Multiply the ones place, regroup if necessary.**
2. **Multiply the ones place in the second factor with the tens place in the first factor. Add the number that was regrouped.**
3. **On the next line, place a 0 in the ones place.**
4. **Multiply the digit in the tens place of the second factor with the ones place in the first factor. Regroup if necessary.**



5. **Multiply each digit in the tens place. Add the number that was regrouped.**
6. **Add both of the products together to get the final answer.**

- Allow time for the students to practice a few problems using the algorithm.
- Model for the students how to use the EMAC strategy using the following problem: *34 x 16* (Teacher Resource Sheet 3)
  - Step 1 – Write the algorithm.
  - Step 2 - Estimate the answer to the problem.
    Use the estimated answer to establish the endpoints on the number line.
    Have the students predict where the exact answer should fall on the number line.
  - Step 3 - Use the paper Base Ten Blocks (Student Resource Sheet 8) to show models of the multiplication problem. **(Teacher Note: Prior to the lesson, color code and cut out the Base Ten Blocks.)**
  - Step 4 - Use a calculator to check the answer to the problem.
  - Step 5 - Then, model for the students how to use the algorithm to multiply by two digit numbers.
  - Step 6 - Finally, place the exact answer on the number line.

Student Application –

- Have the students practice multiplying using the EMAC strategy (Student Resource Sheet 7). Use the following problem: *42 x 17*

Embedded Assessment –

- Observe the students while they complete the EMAC strategy. Be sure to look for their understanding of basic facts, place value, and regrouping. Complete the *Observation Checklist* (Teacher Resource Sheet 2)

Reteaching

- Work with students who are struggling with solving the algorithm by completing the worksheet *Algorithm Extra Practice* (Student Resource Sheet 8). The students will be provided with boxes as a guide to help them correctly place the numbers in the problem.
  Answers can be found on Teacher Resource Sheet 4.

Extension –

- Students who have demonstrated their understanding of multiplying by two digit numbers may visit the following website to practice their multiplication skills and facts:

http://www.oswego.org/ocsd-web/games/SpeedGrid/Multiplication/urikamultires.html

Summative Assessment:

Students will demonstrate their understanding of regrouping and place value in regards to multiplying by two digit numbers in order to complete an assessment (Student Resource Sheet 9). The answer key is on Teacher Resource Sheet 5.

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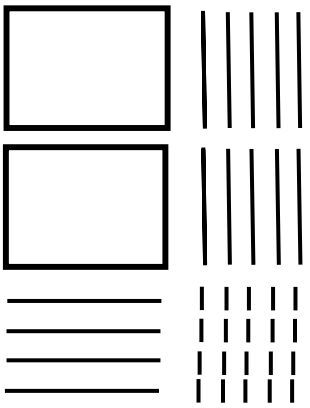
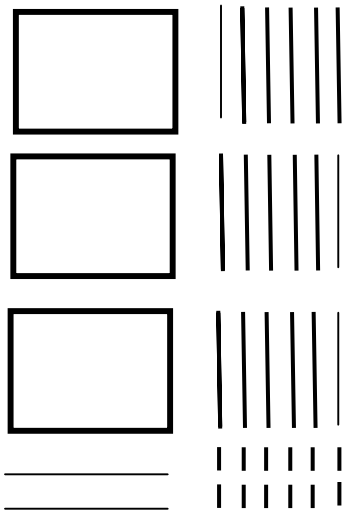
Sample Multiplication Problems
(Base Ten Blocks)

Use Base Ten Blocks to model and solve the following problems with the students:

1. 24 x 15
   (360)



2. 32 X 26
   (832)



Teacher Observation Checklist
Multiplication Magic

Criteria	Names of Students																													
Automaticity of Basic Facts																														
Representation of Place Value																														
Demonstrates Regrouping																														

Teacher Notes / Anecdotal Records

Student Resource Sheet 1

Merlin's Multiplication War

Merlin has decided it is time to practice our marvelous multiplication skills. He has given you each a set of cards. You will realize by the end of this game that magic will not help you solve these problems.

Materials:
1 deck of 2-digit playing cards for each pair of students

Directions:

1. **One player shuffles and divides the cards equally between both players, placing the cards face down between them.**
2. **Each player turns over a card at the same time.**
3. **The first player to say the product of both cards wins and takes the cards.**
4. **Play continues until one player has most (or all) of the cards.**

Variation 1

1. **One player shuffles the cards and places them face down, spreading them out between the two players.**
2. **Both players pick two cards randomly, multiplying the two factors, and say the product.**
3. **Both players show their hands to prove their products.**
4. **The player with the highest product takes all four cards and places them in a separate pile.**

10	20	30	40	50
60	70	80	90	100
200	300	400	500	600
700	800	900	10	20
30	40	50	60	70

Student Resource Sheet 3

Merlin's Multiplication Grid

Materials: 1 set of double number cubes for each group

Directions: You and your partner will solve 2- digit by 2- digit multiplication problems using the decomposition method. First roll the number cube to get a 2-digit factor and write that factor in the top two boxes (one digit per box). Roll the number cube again and write that 2-digit factor in the bottom two boxes. Now multiply by decomposing the numbers to write your answer.

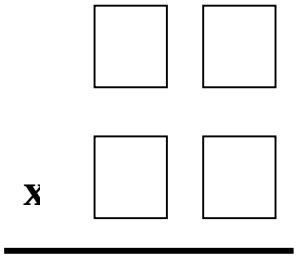
	□	□
x	□	□

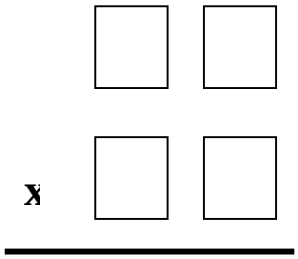
	□	□
x	□	□

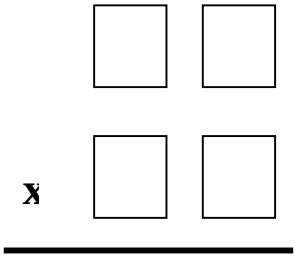
	□	□
x	□	□

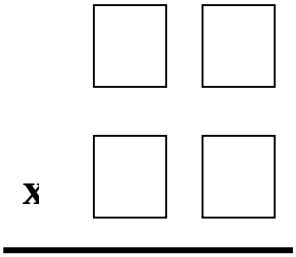
	□	□
x	□	□

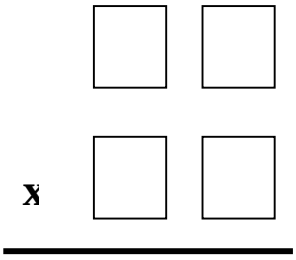
Student Resource Sheet 4

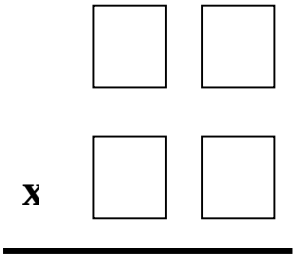


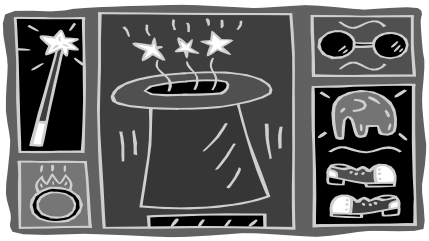












Merlin's Magnificent Bingo

Number of Players: 4 (2 on each team)

Goal: Cover 3 in a row.

Materials: 2 color markers

Dry erase boards & markers or paper/pencil

Game Rules

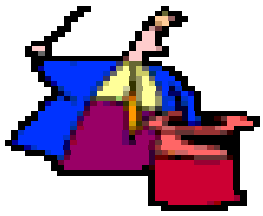
1. Team A picks one factor from each row in the Choice Box. Players use Base Ten Blocks or the method of decomposing numbers using multiplication to find the product. Team A covers the product on the gameboard. (Example: Team A picks 42 and 34. They say 42 times 34 and find the product, 1,428, on the gameboard.
2. Teams take turns.
3. The first team with four markers in a row wins. The rows may be across, down, or diagonally.

Merlin's Bingo Choices

42	21
16	34
83	15
57	75

Student Resource Sheet 6

Merlin's Multiplication Bingo Board



672	1,328	3,150	1,197
1,575	855	4,731	1,125
714	2,394	336	1,428
2,822	510	6,225	240

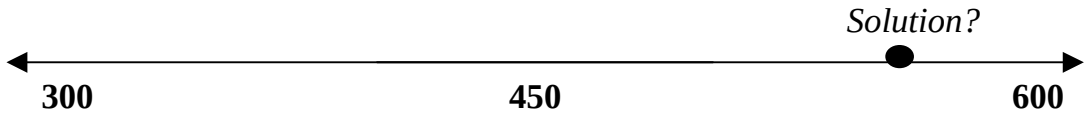
EMAC Example: *Multiplying 2-Digits with Regrouping*

2nd

Estimate

The actual answer might be less than 600 because 16 was rounded up.

34 i s close to 30
x 16 is close to 20
600



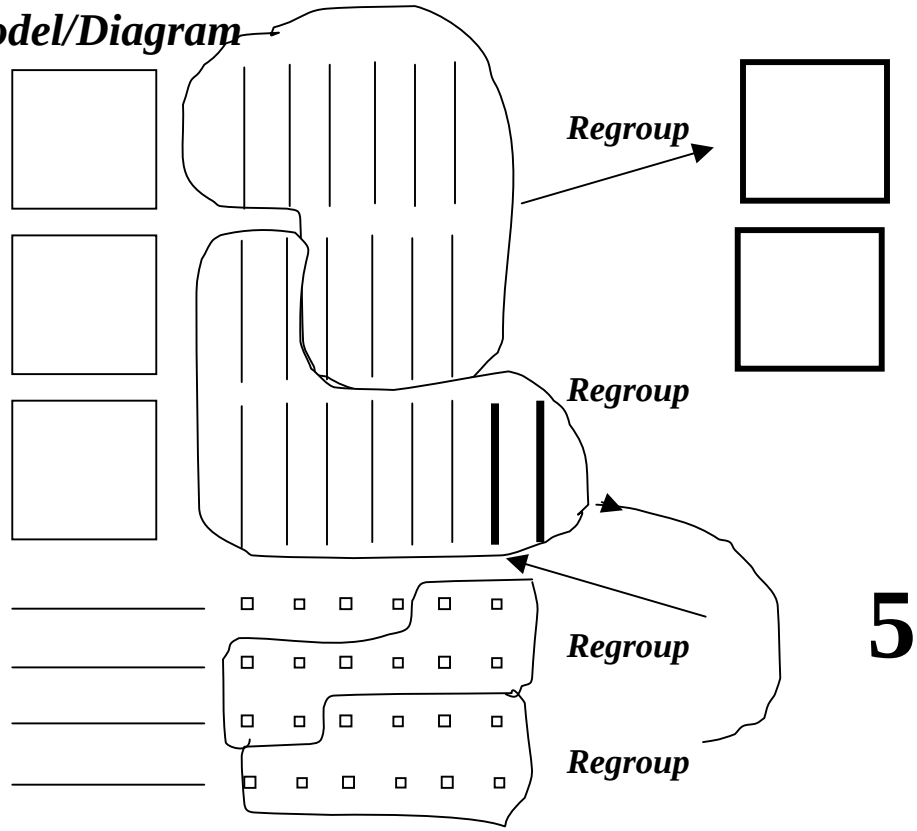
3rd

Algorithm

1st

$$\begin{array}{r} {\scriptstyle 2\ \ } \\ 34 \\ \times\ 16 \\ \hline 204 \\ +340 \\ \hline 544 \end{array}$$

Model/Diagram



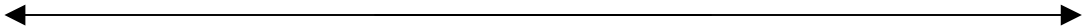
544

4th

Calculator Solution

34 x 16 = 544

Estimate



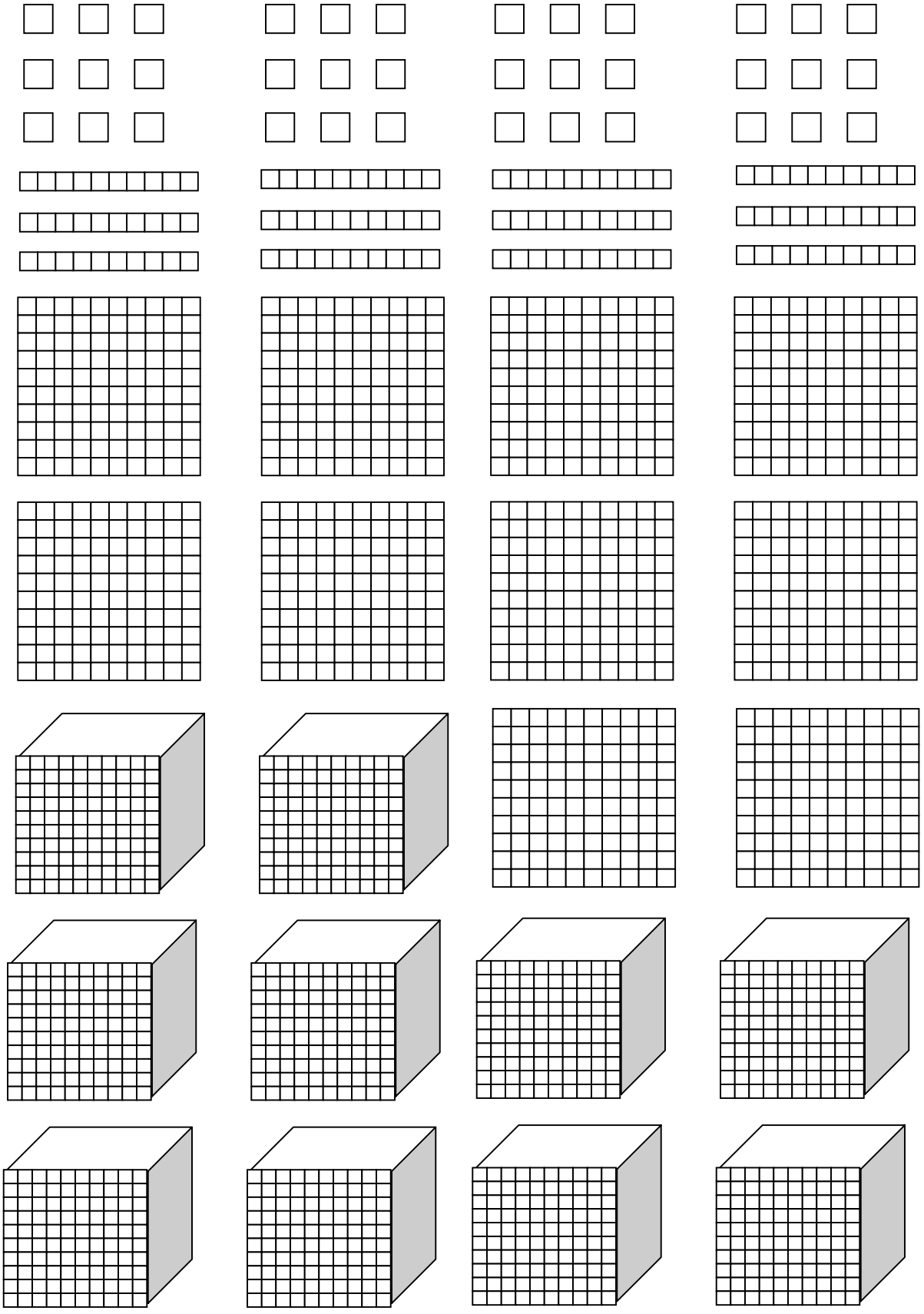
Algorithm

Model/Diagram

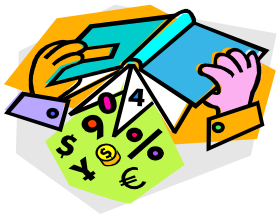
Calculator Solution

Student Resource Sheet 8

Base Ten Blocks Templates

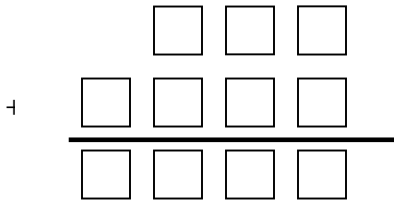


Algorithm Extra Practice



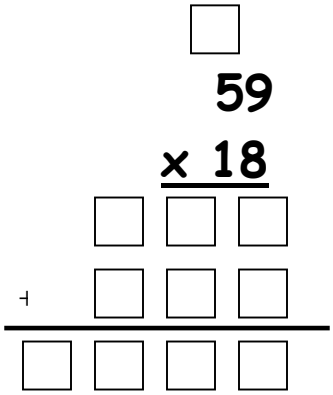
42

x 34



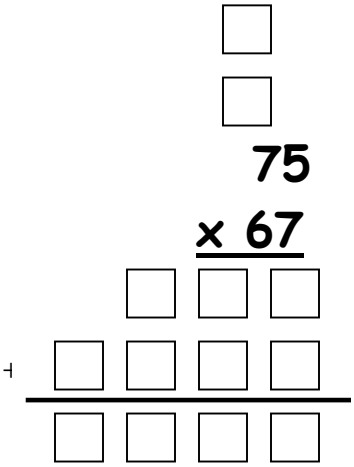
59

x 18



75

x 67



Answer Key: Algorithm Extra Practice

$$\begin{array}{r} 42 \\ \times\ 34 \\ \hline 168 \\ +1260 \\ \hline 1428 \end{array} \qquad \begin{array}{r} 59 \\ \times\ 18 \\ \hline 472 \\ +\ 590 \\ \hline 1062 \end{array}$$

$$\begin{array}{r} 75 \\ \times\ 67 \\ \hline 525 \\ +4500 \\ \hline 5025 \end{array}$$

Summative Assessment

Solve. Choose the correct answer for each problem. Show your work in the space provided or on a separate sheet of paper.

1. 64
   X 38

   a. 704
   b. 2,302
   c. 2,400
   d. 2,432

2. 75
   X 22

   a. 1,540
   b. 1,600
   c. 1,650
   d. 2,000

3. Step A.

Harry solved the following multiplication problem:

$$\begin{array}{r} 48 \\ \times\ 26 \\ \hline 288 \\ +\ 96 \\ \hline 384 \end{array}$$

Step B. Explain why Harry's answer is incorrect? Use words and/or numbers to explain your answer.

4. There were **27** students in Merlin's Magic Class. Each student learned **15** new card tricks. How many card tricks did Merlin's class learn?

A. Solve

B. Use what you know about multiplication to explain why your answer is correct. Use words, numbers, and/or symbols to explain why your answer is correct.

5. The first year it was open 15 students visited Prettyboy School of Magic each day for the entire month of September. How many students attended the school in September?

Step A. Solve.

Step B.

- Use what you know about multiplication to explain how your answer is correct. Use words, numbers, and/or symbols to explain.
- The following year 17 students visited the Prettyboy School of Magic each day in the entire month of September. Which year had more students? The first year or the second year? Explain how you know?

Summative Assessment
Answer Key

Solve. Choose the correct answer for each problem.

1. 64
   X 38

   a. 704
   b. 2,302
   c. 2,400
   d. 2,432

2. 75
   X 22

   a. 1,540
   b. 1,600
   c. 1,650
   d. 2,000

3. Step A.

Harry solved the following multiplication problem incorrectly. Correct his problem and write the correct solution. **(1 point)**

48	**48**
X26	**x26**
288	**288**
+ 96	**+960**
384	**1,248**

Step B. Explain why Harry's answer is incorrect? Use words and/or numbers to explain your answer. **(2 points)**

Score	**Criteria**
2	Effective use of a strategy to solve the problem
	Applied mathematical thinking and reasoning correctly
	Used appropriate vocabulary to somewhat explain the solution
	Used numbers, words, and/or symbols
1	**Used Strategy to solve the problem**
	Attempted to apply mathematical thinking and reasoning
	Used appropriate vocabulary to fully explain the solution
	Used numbers, words, and/or symbols
0	Ineffective use of a strategy to solve the problem correctly
	No attempt to apply mathematical thinking and reasoning
	Left answer bank

4. There were **27** students in Merlin's Magic Class. Each student learned **15** new card tricks. How many card tricks did Merlin's class learn? **(1 point)**

A. Solve.

$$\begin{array}{r} 27 \\ \times 15 \\ \hline 135 \\ +\ 270 \\ \hline 405 \end{array}$$

C. Use what you know about multiplication to explain why your answer is correct. Use words, numbers, and/or symbols to explain why your answer is correct. **(2 points)**

Score	Criteria
2	Effective use of a strategy to solve the problem
	Applied mathematical thinking and reasoning correctly
	Used appropriate vocabulary to somewhat explain the solution
	Used numbers, words, and/or symbols
1	**Used Strategy to solve the problem**
	Attempted to apply mathematical thinking and reasoning
	Used appropriate vocabulary to fully explain the solution
	Used numbers, words, and/or symbols
0	Ineffective use of a strategy to solve the problem correctly
	No attempt to apply mathematical thinking and reasoning
	Left answer blank

5. The first year it was open 15 students visited Prettyboy School of Magic each day for the entire month of September. How many students attended the school in September? **(1 point)**

Step A. Solve. 15

X30

0

+ 450

450

Step B.

- Use what you know about multiplication to explain how your answer is correct. Use words, numbers, and/or symbols to explain.
- The following year 17 students visited the Prettyboy School of Magic each day in the entire month of September. Which year had more students? The first year or the second year? Explain how you know? **510 – 450 = 60 2nd yr**.

Score	Criteria
3	**Very effective use of a strategy to correctly solve the problem**
	Applied mathematical thinking and reasoning correctly
	Used appropriate vocabulary to fully explain the solution
	Used numbers, words, and/or symbols effectively
2	Effective use of a strategy to solve the problem
	Applied mathematical thinking and reasoning correctly
	Used appropriate vocabulary to somewhat explain the solution
	Used numbers, words, and/or symbols
1	**Used Strategy to solve the problem**
	Attempted to apply mathematical thinking and reasoning
	Used appropriate vocabulary to fully explain the solution
	Used numbers, words, and/or symbols
0	Ineffective use of a strategy to solve the problem correctly
	No attempt to apply mathematical thinking and reasoning
	Left answer blank