**Lesson 9 Notes: Multiplication of Whole Numbers**

**ANSWER KEY**

**Definition of Multiplication:**

repeated addition!

A x B = B + B + B + B….+ B (A times….)

A and B are called Factors!

Their Multiplication is called the PRODUCT.

Since multiplication is really repeated addition, we can adapt our addition model to become a multiplication model as well.  Let’s think about 3 × 4.  This means to add four to itself three times (that’s simply the definition of multiplication!):

3 × 4 = 4 + 4 + 4.

So to multiply on the number line, we do the process for addition several times.

To multiply two numbers, Zed starts at 0 as always, and he faces the positive direction. He walks forward the number of steps given by the second number (the second *factor*).   He repeats that process the number of times given by the first number (the first *factor*). Where he lands is the *product* of the two numbers.

If Zed wants to multiply 3 × 4……..

He ends at the number 12, so the product of 3 and 4 is 12. That is, 3 × 4 = 12.

[Textbook Video](https://www.youtube.com/watch?v=VUDiE3o3o4o&t=14s)

A screenshot of a computer

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**Algorithms for Multiplication**

1. Repeated Addition
2. Traditional
3. Partial Products
4. Lattice

**Repeated Addition Algorithm for Multiplication**

2 x 5 5 + 5 = 10

6 x 7 7 + 7 + 7 + 7 + 7 + 7 =42

**Traditional Algorithm for Multiplication**

83 x 27 249 x 73

249

X 73

747

+ 17430

18,177

83

X 27

581

+1660

2241

**Partial Products Algorithm for Multiplication**

Sometimes called the BOX METHOD. Take the value of each factor and form the product of all pairs, then ADD all answers

83 x 27 249 x 73

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98 x 35 18 x 23

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382 x 56

***Try It! Show your work!***

382 x 56 = 21,392

**Lattice Algorithm for Multiplication**

Numbers are written around a box with diagonals separating each box. Multiply numbers, put the answers in the box, and ADD along the diagonals!

83 x 27 249 x 73

A grid of lines with red numbers

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98 x 35 382 x 56

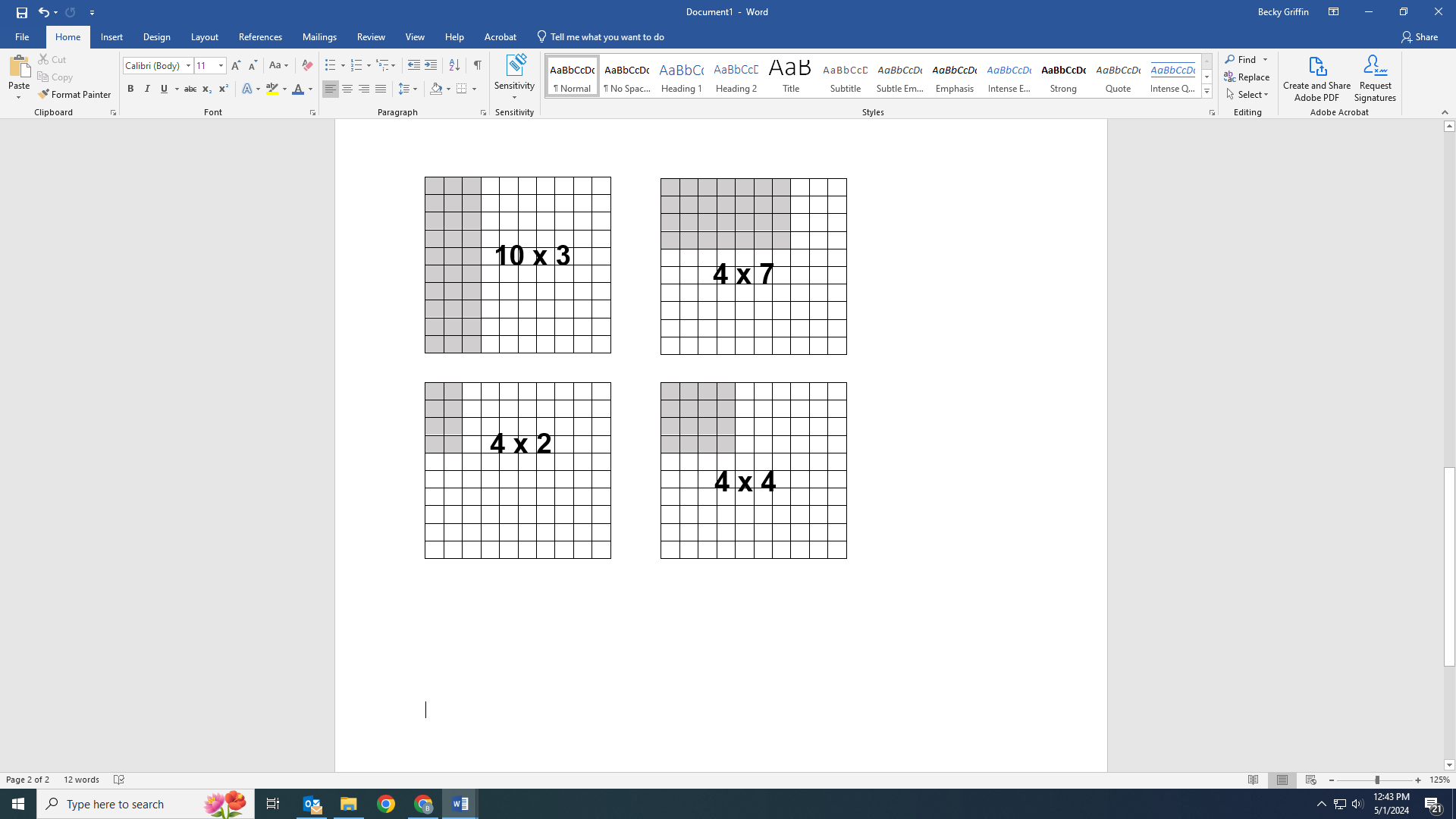
A diagram of a grid with numbers and lines

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***Try It! Show your work!***

382 x 56 = 21,392

**Array and Area Model for Multiplication**



**Example**: Draw an array and area model for 2 x 6.

ANSWER:

A grid with blue numbers and a rectangular rectangle

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*NCTM Standards: Instruction should emphasize the development of an estimation mindset. Children should come to know what is meant by an estimate, when it is appropriate to estimate, and how close an estimate is required in a given situation. If children are encouraged to estimate, they will accept estimation as a legitimate part of mathematics. When students leave grade 5, they should be able to solve many problems mentally, to estimate a reasonable result for a problem, and to compute fluently with multidigit whole numbers.*

**Properties for Multiplication**

**Commutative –** A x B = B x A

**Associative –** Grouping

A x (B x C) = (A x B) x C

**Identity –** A x 1 = A

**Distributive –** A (B + C) = AB + AC

**Closure** **–** Perform an operation on a set of numbers and the answer is also in that set

**Property of 0 –** A x 0 = 0

**Mental Computation and Estimation**

**Mental Computation –**

Rounding

* Rounding is “risky” in multiplication because any error due to rounding becomes multiplied!
* Round to place value of leading digit, but to get more accurate, round one “up” and one “down”

28 X 63 30 x 60 = 1800

**Compatible Numbers-**

* Replacing a number with a number more easily to compute mentally

2 x 117 X 49 Replace 49 with 50 and then estimate the answer.

2 x 117 x 50 = 100 x 117 = 11,700

**Estimation-**

Front-End Estimation – the leading digit of each number is used to obtain an estimated product.

43 x 72 40 x 70 = 2800

237 x 76 200 x 70 = 14,000