



Georgia Standards of Excellence Frameworks

Mathematics

GSE Third Grade

Unit 2: The Relationship Between
Multiplication and Division



Richard Woods, Georgia's School Superintendent
"Educating Georgia's Future"

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TABLE OF CONTENTS

Unit Overview.....	3
Standards for Mathematical Practice	5
Content Standards	6
Big Ideas	7
Essential Questions	8
Concepts & Skills to Maintain.....	8
Strategies for Teaching and Learning.....	9
Selected Terms and Symbols	14
Tasks.....	15
One Hundred Hungry Ants!	20
Arrays on the Farm	23
What’s My Product?	39
The Doorbell Rang.....	43
Family Reunion.....	48
Skittles Cupcake Combos	58
Seating Arrangements.....	61
Stuck on Division.....	65
Apple Solar Farm.....	71
Base Ten Multiplication.....	79
Multiples of Tens	86
How Many Tens?.....	90
What Comes First, the Chicken or the Egg?.....	94
Sharing Pumpkin Seeds	98
Egg Tower.....	103
Array-ning our Fact Families.....	111
Finding Factors	115
Shake, Rattle, and Roll Revisited	124
Use What You Know	128
Multiplication Chart Mastery.....	133
Making the “Hard” Facts Easy	138
Find the Unknown Number	144
Making Up Multiplication	151
Field Day Blunder.....	158
Leap Frog.....	162
Our Favorite Candy.....	166
 Culminating Tasks	
My Special Day.....	170
Ice Cream Scoops	174

OVERVIEW

In this unit, students will:

- begin to understand the concepts of multiplication and division
- learn the basic facts of multiplication and their related division facts
- apply properties of operations (commutative, associative, and distributive) as strategies to multiply and divide
- understand division as an unknown-factor problem. For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8.
- fluently multiply and divide within 100, using strategies such as the patterns and relationships between multiplication and division
- understand multiplication and division as inverse operations
- solve problems and explain their processes of solving division problems that can also be represented as unknown factor multiplication problems.
- represent and interpret data

“Multiplication and division are commonly taught separately. However, it is very important to combine the two shortly after multiplication has been introduced. This will help the students to see the connection between the two.” (Van de Walle and Lovin, *Teaching Student-Centered Mathematics 3-5*, p. 60)

Students develop an understanding of the meanings of multiplication and division of whole numbers through activities and problems involving equal-sized groups, arrays, and area models; multiplication is finding an unknown product, and division is finding an unknown factor in these situations. For equal-sized group situations, division can require finding the unknown number of groups or the unknown group size.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision during this cluster are: operation, multiply, divide, factor, product, quotient, strategies, and properties-rules about how numbers work.

Georgia Department of Education
 Georgia Standards of Excellence Framework
 GSE The Relationship Between Multiplication and Division • Unit #2

	Unknown Product	Group Size Unknown (“How many in each group? Division)	Number of Groups Unknown (“How many groups?” Division)
	$3 \times 6 = ?$	$3 \times ? = 18$, and $18 \div 3 = ?$	$? \times 6 = 18$, and $18 \div 6 = ?$
Equal Groups	<p>There are 3 bags with 6 plums in each bag. How many plums are there in all?</p> <p><i>Measurement example.</i> You need 3 lengths of string, each 6 inches long. How much string will you need altogether?</p>	<p>If 18 plums are shared equally into 3 bags, then how many plums will be in each bag?</p> <p><i>Measurement example.</i> You have 18 inches of string, which you will cut into 3 equal pieces. How long will each piece of string be?</p>	<p>If 18 plums are to be packed 6 to a bag, then how many bags are needed?</p> <p><i>Measurement example.</i> You have 18 inches of string, which you will cut into pieces that are 6 inches long. How many pieces of string will you have?</p>
Arrays¹, Area²	<p>There are 3 rows of apples with 6 apples in each row. How many apples are there?</p> <p><i>Area example.</i> What is the area of a 3 cm by 6 cm rectangle?</p>	<p>If 18 apples are arranged into 3 equal rows, how many apples will be in each row?</p> <p><i>Area example.</i> A rectangle has area 18 square centimeters. If one side is 3 cm long, how long is a side next to it?</p>	<p>If 18 apples are arranged into equal rows of 6 apples, how many rows will there be?</p> <p><i>Area example.</i> A rectangle has area 18 square centimeters. If one side is 6 cm long, how long is a side next to it?</p>
Compare	<p>A blue hat costs \$6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost?</p> <p><i>Measurement example.</i> A rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?</p>	<p>A red hat costs \$18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost?</p> <p><i>Measurement example.</i> A rubber band is stretched to be 18 cm long and that is 3 times as long as it was at first. How long was the rubber band at first?</p>	<p>A red hat costs \$18 and a blue hat costs \$6. How many times as much does the red hat cost as the blue hat?</p> <p><i>Measurement example.</i> A rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?</p>
General	$a \times b = ?$	$a \times ? = p$, and $p \div a = ?$	$? \times b = p$, and $p \div b = ?$

Adapted from Common Core State Standards Glossary, pg. 89

COMMON MULTIPLICATION AND DIVISION SITUATIONS

¹ The language in the array examples shows the easiest form of array problems. A harder form is to use the terms rows and columns: The apples in the grocery window are in 3 rows and 6 columns. How many apples are in there? Both forms are valuable.

² Area involves arrays of squares that have been pushed together so that there are no gaps or overlaps, so array problems include these especially important measurement situations. The first examples in each cell are examples of discrete things. These are easier for students and should be given before the measurement examples.

STANDARDS FOR MATHEMATICAL PRACTICE (SMP)

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important “processes and proficiencies” with longstanding importance in mathematics education.

This section provides examples of learning experiences for this unit that support the development of the proficiencies described in the Standards for Mathematical Practice. The statements provided offer a few examples of connections between the Standards for Mathematical Practice and the Content Standards of this unit. The list is not exhaustive and will hopefully prompt further reflection and discussion.

1. **Make sense of problems and persevere in solving them.** Students make sense of problems involving multiplication and division.
2. **Reason abstractly and quantitatively.** Students demonstrate abstract reasoning by connecting arrays with multiplication problems.
3. **Construct viable arguments and critique the reasoning of others.** Students construct and critique arguments regarding mental math strategies focusing on multiplication and division.
4. **Model with mathematics.** Students are asked to use tiles to model various understandings of multiplication by creating arrays or groups. They record their thinking using words, pictures, and numbers to further explain their reasoning.
5. **Use appropriate tools strategically.** Students use graph paper to find all the possible rectangles for a given product.
6. **Attend to precision.** Students will learn to use terms such as multiply, divide, factor, and product with increasing precision.
7. **Look for and make use of structure.** Students use the distributive property of multiplication as a strategy to multiply.
8. **Look for and express regularity in repeated reasoning.** Students use the distributive property of multiplication to solve for products they do not know.

**Mathematical Practices 1 and 6 should be evident in EVERY lesson!*

CONTENT STANDARDS

Represent and solve problems involving multiplication and division.

MGSE3.OA.1 Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5×7 .*

MGSE3.OA.2 Interpret whole number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares (How many in each group?), or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each (How many groups can you make?). *For example, describe a context in which a number of shares or a number of groups can be expressed as $56 \div 8$.*

MGSE3.OA.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.³

MGSE3.OA.4 Determine the unknown whole number in a multiplication or division equation relating three whole numbers using the inverse relationship of multiplication and division. For example, determine the unknown number that makes the equation true in each of the equations, $8 \times ? = 48$, $5 = \square \div 3$, $6 \times 6 = ?$.

Understand properties of multiplication and the relationship between multiplication and division.

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.⁴
Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.)
Use arrays, area models, and manipulatives to develop understanding of properties.

MGSE3.OA.6. Understand division as an unknown-factor problem.
For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8.
Conversations should also include connections between division and subtraction.

MGSE3.OA.7 Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that $8 \times 5 = 40$, one knows $40 \div 5 = 8$) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.

³ See glossary, Table 2.

⁴ Students need not use formal terms for these properties.

Use place value understanding and properties of operations to perform multi-digit arithmetic.⁵

MGSE3.NBT.3 Multiply one-digit whole numbers by multiples of 10 in the range 10-90 (e.g., 9×80 , 5×60) using strategies based on place value and properties of operations.

Represent and interpret data.

MGSE3.MD.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.*

MGSE3.MD.4. Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

[For more detailed information about unpacking the content standards, unpacking a task, math routines and rituals, maintenance activities and more, please refer to the Grade Level Overview.](#)

BIG IDEAS

- Multiplication and division are inverse operations.
- Multiplication and division can be modeled with arrays.
- Multiplication is commutative, but division is not.
- There are two common situations where division may be used.
 - Partition (or fair-sharing) - given the total amount and the number of equal groups, determine how many/much in each group
 - Measurement (or repeated subtraction) - given the total amount and the amount in a group, determine how many groups of the same size can be created.
- As the divisor increases, the quotient decreases; as the divisor decreases, the quotient increases.
- There is a relationship between the divisor, the dividend, the quotient, and any remainder.
- The associative property of multiplication can be used to simplify computation.
- The distributive property of multiplication allows us to find partial products and then find their sum.

⁵ A range of algorithms will be used.

ESSENTIAL QUESTIONS

- How are multiplication and division related?
- How can you write a mathematical sentence to represent a multiplication or division model we have made?
- How do estimation, multiplication, and division help us solve problems in everyday life?
- How does understanding the properties of operations help us multiply large numbers?

CONCEPTS & SKILLS TO MAINTAIN

In Grade 2, instructional time focused on four critical areas:

- Furthering their understanding for the base-ten system. Students worked with counting in fives, tens and multiples of hundreds, tens and ones. Students also recognize that the digits in each place of a number represent the amounts of thousands, hundreds, tens, or ones.
- Using their understanding of addition to develop fluency within 100. They solve problems within 1,000 by using models of addition and subtraction.
- Recognizing the need for units of measure (centimeter and inch) and understand how to use rulers and other measurement tools to get linear measurement.
- Developing an understanding of shapes by analyzing and describing them based on their sides and angles.

Specifically, it is expected that students will have prior knowledge/experience related to the concepts and skills identified below. It may be necessary to pre-assess in order to determine if time needs to be spent on conceptual activities that help students develop a deeper understanding of these ideas.

- odd and even numbers
- skip counting by twos, threes, fives, and tens
- determining reasonableness using estimation
- addition and subtraction as inverse operations
- commutative, associative, and identity properties of addition
- basic addition facts
- making tens in a variety of ways
- basic subtraction facts
- place value for ones, tens, hundreds, and thousands
- modeling numbers using base 10 blocks and on grid paper
- using addition to find the total number of objects in a rectangular array

Fluency: Procedural fluency is defined as skill in carrying out procedures flexibly, accurately, efficiently, and appropriately. Fluent problem solving does not necessarily mean solving problems within a certain time limit, though there are reasonable limits on how long computation should take. Fluency is based on a deep understanding of quantity and number.

Deep Understanding: Teachers teach more than simply “how to get the answer” and instead support students’ ability to access concepts from a number of perspectives. Therefore students are able to see math as more than a set of mnemonics or discrete procedures. Students demonstrate deep conceptual understanding of foundational mathematics concepts by applying them to new situations, as well as writing and speaking about their understanding.

Memorization: The rapid recall of arithmetic facts or mathematical procedures. Memorization is often confused with fluency. Fluency implies a much richer kind of mathematical knowledge and experience.

Number Sense: Students consider the context of a problem, look at the numbers in a problem, make a decision about which strategy would be most efficient in each particular problem. Number sense is not a deep understanding of a single strategy, but rather the ability to think flexibly between a variety of strategies in context.

Fluent students:

- flexibly use a combination of deep understanding, number sense, and memorization.
- are fluent in the necessary baseline functions in mathematics so that they are able to spend their thinking and processing time unpacking problems and making meaning from them.
- are able to articulate their reasoning.
- find solutions through a number of different paths.

For more about fluency, see: <http://www.youcubed.org/wp-content/uploads/2015/03/FluencyWithoutFear-2015.pdf> and: <http://joboaler.com/timed-tests-and-the-development-of-math-anxiety/>

STRATEGIES FOR TEACHING AND LEARNING

(Adapted from Common Core Resources, NC Dept. of Public Instruction)

Represent and solve problems involving multiplication and division.

In Grade 2, students found the total number of objects using rectangular arrays, such as a 5 x 5, and wrote equations to represent the sum. This strategy is a foundation for multiplication because students should make a connection between repeated addition and multiplication.

Students need to experience problem-solving involving equal groups (whole unknown or size of group is unknown) and multiplicative comparison (unknown product, group size unknown or number of groups unknown) as shown in the table in the unit overview. No attempt should be made to teach the abstract structure of these problems.

Encourage students to solve these problems in different ways to show the same idea and be able to explain their thinking verbally and in written expression. Allowing students to present several different strategies provides the opportunity for them to compare strategies.

Sets of counters, number lines to skip count and relate to multiplication and arrays/area models will aid students in solving problems involving multiplication and division. Allow students to model problems using these tools. They should represent the model used as a drawing or equation to find the solution.



This shows multiplication using grouping with 3 groups of 5 objects and can be written as 3×5 .

Provide a variety of contexts and tasks so that students will have more opportunity to develop and use thinking strategies to support and reinforce learning of basic multiplication and division facts.

Have students create multiplication problem situations in which they interpret the product of whole numbers as the total number of objects in a group and write as an expression. Also, have students create division-problem situations in which they interpret the quotient of whole numbers as the number of shares.

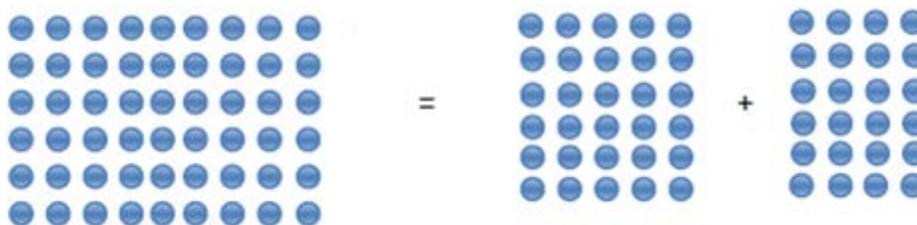
Students can use known multiplication facts to determine the unknown fact in a multiplication or division problem. Have them write a multiplication or division equation and the related multiplication or division equation. For example, to determine the unknown whole number in $27 \div \square = 3$, students should

ask themselves questions such as, “How many 3s are in 27 ?” or “3 times what number is 27?” Have them justify their thinking with models or drawings.

Students need to apply properties of operations (commutative, associative and distributive) as strategies to multiply and divide. Applying the concept involved is more important than students knowing the name of the property. Understanding the commutative property of multiplication is developed through the use of models as basic multiplication facts are learned. For example, the result of multiplying 3×5 (15) is the same as the result of multiplying 5×3 (15).

To find the product of three numbers, students can use what they know about the product of two of the factors and multiply this by the third factor. For example, to multiply $5 \times 7 \times 2$, students know that 5×2 is 10. Then, they can use mental math to find the product of 10×7 (70). Allow students to use their own strategies and share with the class when applying the associative property of multiplication.

Splitting arrays can help students understand the distributive property. They can use a known fact to learn other facts that may cause difficulty. For example, students can split a 6×9 array into 6 groups of 5 and 6 groups of 4; then, add the sums of the groups.



The 6 groups of 5 is 30 and the 6 groups of 4 is 24. Students can write 6×9 as $6 \times 5 + 6 \times 4$. Students' understanding of the part/whole relationships is critical in understanding the connection between multiplication and division.

Multiply and divide within 100

Students need to understand the part/whole relationships in order to understand the connection between multiplication and division. They need to develop efficient strategies that lead to the big ideas of multiplication and division. These big ideas include understanding the properties of operations, such as the commutative and associative properties of multiplication and the distributive property. The naming of the property is not necessary at this stage of learning.

In Grade 2, students found the total number of objects using rectangular arrays, such as a 5×5 , and wrote equations to represent the sum. This is called unitizing, and it requires students to count groups, not just objects. They see the whole as a number of groups of a number of objects. This strategy is a foundation for multiplication in that students should make a connection between repeated addition and multiplication.

As students create arrays for multiplication using objects or drawing on graph paper, they may discover that three groups of four and four groups of three yield the same results. They should observe that the arrays stay the same, although how they are viewed changes. Provide numerous situations for students to develop this understanding.



To develop an understanding of the distributive property, students need decompose the whole into groups. Arrays can be used to develop this understanding. To find the product of 3×9 , students can decompose 9 into the sum of 4 and 5 and find $3 \times (4 + 5)$.



The distributive property is the basis for the standard multiplication algorithm that students can use to fluently multiply multi-digit whole numbers in Grade 5.

Once students have an understanding of multiplication using efficient strategies, they should make the connection to division. Using various strategies to solve different contextual problems that use the same two one-digit whole numbers requiring multiplication allows for students to commit to memory all products of two one-digit numbers.

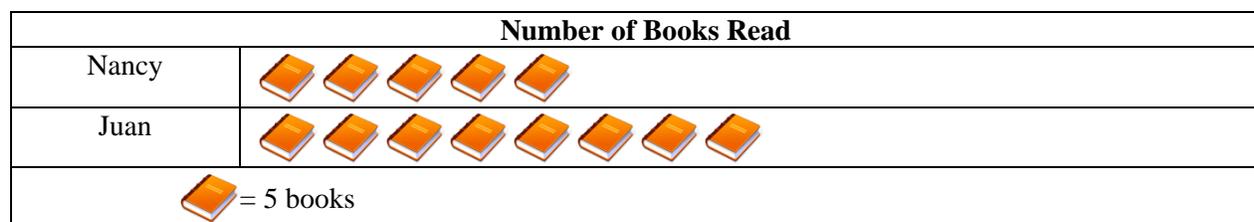
Represent and interpret data.

Representation of a data set is extended from picture graphs and bar graphs with single-unit scales to scaled picture graphs and scaled bar graphs. Intervals for the graphs should relate to multiplication and division with 100 (product is 100 or less and numbers used in division are 100 or less). In picture graphs, use values for the icons in which students are having difficulty with multiplication facts. For example, ☺ represents 7 people. If there are three ☺, students should use known facts to determine that the three icons represents 21 people. The intervals on the vertical scale in bar graphs should not exceed 100.

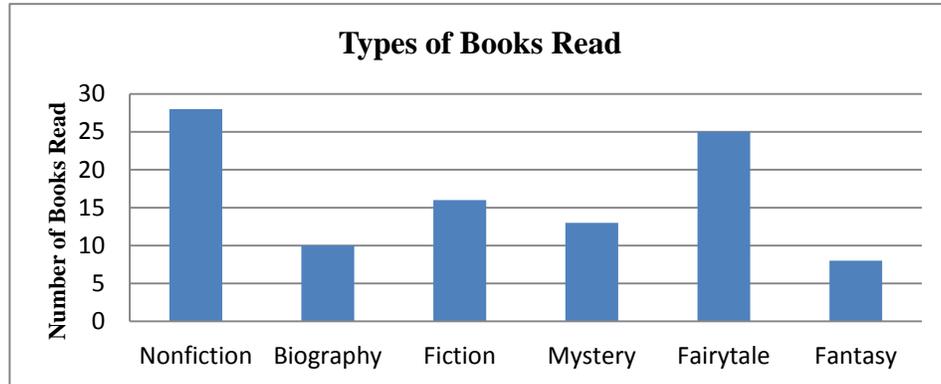
Students are to draw picture graphs in which a symbol or picture represents more than one object. Bar graphs are drawn with intervals greater than one. Ask questions that require students to compare quantities and use mathematical concepts and skills. Use symbols on picture graphs that student can easily represent half of, or know how many half of the symbol represents. Students are to measure lengths using rulers marked with halves and fourths of an inch and record the data on a line plot. The horizontal scale of the line plot is marked off in whole numbers, halves or fourths. Students can create rulers with appropriate markings and use the ruler to create the line plots.

Although intervals on a bar graph are not in single units, students count each square as one. To avoid this error, have students include tick marks between each interval. Students should begin each scale with 0. They should think of skip-counting when determining the value of a bar since the scale is not in single units.

Pictographs: Scaled pictographs include symbols that represent multiple units. Below is an example of a pictograph with symbols that represent multiple units. Graphs should include a title, categories, category label, key, and data. How many more books did Juan read than Nancy?



Single Bar Graphs: Students use both horizontal and vertical bar graphs. Bar graphs include a title, scale, scale label, categories, category label, and data.



Analyze and Interpret data:

- How many more nonfiction books were read than fantasy books?
- Did more people read biography and mystery books or fiction and fantasy books?
- About how many books in all genres were read?
- Using the data from the graphs, what type of book was read more often than a mystery but less often than a fairytale?
- What interval was used for this scale?
- What can we say about types of books read? What is a typical type of book read?
- If you were to purchase a book for the class library which would be the best genre? Why?

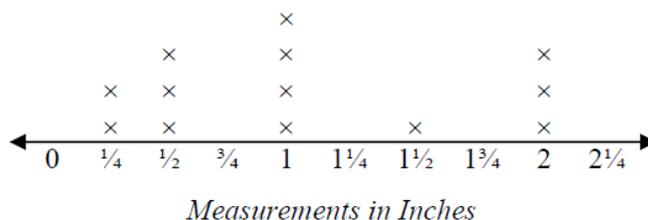
Students in second grade measured length in whole units using both metric and U.S. customary systems. It is important to review with students how to read and use a standard ruler including details about halves and quarter marks on the ruler. Students should connect their understanding of fractions to measuring to one-half and one-quarter inch. Third graders need many opportunities measuring the length of various objects in their environment.

This standard provides a context for students to work with fractions by measuring objects to a quarter of an inch.

Example:

Measure objects in your desk to the nearest $\frac{1}{2}$ or $\frac{1}{4}$ of an inch, display data collected on a line plot. How many objects measured $\frac{1}{4}$? $\frac{1}{2}$? etc. ...

Objects on My Desk



**For additional assistance see the [Unit Webinar](http://georgiastandards.org) at georgiastandards.org.

SELECTED TERMS AND SYMBOLS

The following terms and symbols are often misunderstood. These concepts are not an inclusive list and should not be taught in isolation. However, due to evidence of frequent difficulty and misunderstanding associated with these concepts, instructors should pay particular attention to them and how their students are able to explain and apply them.

The terms below are **for teacher reference only** and are not to be memorized by the students. Teachers should present these concepts to students with models and real life examples. Students should understand the concepts involved and be able to recognize and/or demonstrate them with words, models, pictures, or numbers. [Mathematics Glossary](#)

- array
- array
- associative property of multiplication
- bar graph
- commutative property of multiplication
- distributive property
- dividend
- division
- divisor
- equal groups
- equations
- factor
- fourths
- groups of
- halves
- identity property of multiplication
- inch
- line plot
- measurement division (or repeated subtraction)
- multiplicand

Georgia Department of Education
 Georgia Standards of Excellence Framework
GSE The Relationship Between Multiplication and Division • Unit #2

- multiplication
- multiplier
- partial products
- partition division
- partitioned equally
- picture graph
- product
- quotient
- remainder
- scale
- strategy
- unknown
- whole numbers

TASKS

Although the units in this instructional framework emphasize key standards and big ideas at specific times of the year, routine topics such as estimation, mental computation, and basic computation facts should be addressed on an ongoing basis. Ideas related to the eight practice standards should be addressed constantly as well. This unit provides much needed content information and excellent learning activities. However, the intent of the framework is not to provide a comprehensive resource for the implementation of all standards in Unit 2. A variety of resources should be utilized to supplement this unit. The tasks in this unit framework illustrated the types of learning activities that should be utilized from a variety of sources. To assure that this unit is taught with the appropriate emphasis, depth, and rigor, it is important that the **“Strategies for Teaching and Learning”** and the tasks listed under **“Evidence of Learning”** be reviewed early in the planning process.

Scaffolding Task	Tasks that build up to the learning task.
Constructing Task	Constructing understanding through deep/rich contextualized problem solving tasks.
Practice Task	Tasks that provide students opportunities to practice skills and concepts.
Performance Task	Tasks which may be a formative or summative assessment that checks for student understanding/misunderstanding and or progress toward the standard/learning goals at different points during a unit of instruction.
Culminating Task	Designed to require students to use several concepts learned during the unit to answer a new or unique situation. Allows students to give evidence of their own understanding toward the mastery of the standard and requires them to extend their chain of mathematical reasoning.

Georgia Department of Education
Georgia Standards of Excellence Framework
GSE The Relationship Between Multiplication and Division • Unit #2

Formative Assessment Lesson (FAL)	Lessons that support teachers in formative assessment which both reveal and develop students' understanding of key mathematical ideas and applications. These lessons enable teachers and students to monitor in more detail their progress towards the targets of the standards.
CTE Classroom Tasks	Designed to demonstrate how the MGSE and Career and Technical Education knowledge and skills can be integrated. The tasks provide teachers with realistic applications that combine mathematics and CTE content.
3-Act Task	A Three-Act Task is a whole-group mathematics task consisting of 3 distinct parts: an engaging and perplexing Act One, an information and solution seeking Act Two, and a solution discussion and solution revealing Act Three. More information along with guidelines for 3-Act Tasks may be found in the <i>Guide to Three-Act Tasks</i> on georgiastandards.org and the K-5 GSE Mathematics Wiki.

Georgia Department of Education
 Georgia Standards of Excellence Framework
 GSE The Relationship Between Multiplication and Division • Unit #2

Task Name	Task Type Grouping Strategy	Skills	Standard(s)	Description
One Hundred Hungry Ants!	Scaffolding Task <i>Individual/Partners</i>	Multiplication and Arrays	MGSE3.OA.1	In this task, students will determine the factors of a product by creating equal groups of counters/colored tiles.
Arrays on the Farm	Scaffolding Task <i>Small Group/Partners</i>	Multiplication and Arrays	MGSE3.OA.5	In this task, the students use arrays to solve multiplication problems. Farmers grow their crops in arrays to make them easier to look after and to harvest.
What's My Product?	Scaffolding Task <i>Individual/Partners</i>	Multiplication	MGSE3.OA.1	This task allows students to interpret products of whole numbers by creating equal groups with manipulatives.
The Doorbell Rang	Scaffolding Task <i>Individual/Partners</i>	Division	MGSE3.OA.2	In this task, students will be introduced to division.
Family Reunion	Constructing Task <i>Individual/Partners</i>	Multiplication and Division	MGSE3.OA.5 MGSE3.OA.6	This task is a two part task. Part I introduces and scaffolds learning of the associative property. In Part II students will be constructing the associative property.
Skittles Cupcake Combos	Constructing Task <i>Individual/Partners</i>	Division	MGSE3.OA.3	This task assesses students' understanding of division and their ability to organize data.
Seating Arrangements	Constructing Task <i>Individual/Partners</i>	Multiplication and Arrays	MGSE3.OA.5	In this task, students will solve a word problem requiring them to make arrays using the number 24.
Stuck on Division	Scaffolding Task <i>Individual/Partners</i>	Division	MGSE3.OA.2	In this task, students will experiment with a set of 12 connecting cubes to determine the division patterns when the dividend is 12.
Apple Solar Farm	3-Act Task <i>Whole Group</i>	Multiples of Ten, Multiplying 1 digit numbers by multiples of 10	MGSE3.NBT.3	In this task, students will look at a picture and tell what they noticed. Next, they will be asked to discuss what they wonder about or are curious about. Students will then use mathematics to answer their own questions.

Georgia Department of Education
 Georgia Standards of Excellence Framework
 GSE The Relationship Between Multiplication and Division • Unit #2

<u>Base Ten Multiplication</u>	Practice Task <i>Partners</i>	Multiplication	MGSE3.OA.1	In this task students determine the factors of 100 by creating addition and/or multiplication models by using Base Ten Blocks.
<u>Multiples of Tens</u>	Scaffolding Task <i>Partners/Small Group</i>	Multiples of Ten	MGSE3.NBT.3	This task allows students to apply their understanding of place value to multiplication of tens.
<u>How Many Tens?</u>	Constructing Task <i>Small Group</i>	Multiplying 1 digit numbers by multiples of 10	MGSE3.NBT.3	This task further relates multiples of ten to place value by giving students the opportunity to build onto the concept that 10 tens equal one hundred, and 10 hundreds equal one thousand.
<u>What Comes First, the Chicken or the Egg?</u>	Constructing Task <i>Individual/Partners</i>	Division	MGSE3.OA.4	In this task, students will use estimation skills to multiply by groups of ten.
<u>Sharing Pumpkin Seeds</u>	Constructing Task <i>Individual/Partners</i>	Division	MGSE3.OA.2 MGSE3.OA.3	In this task, students will decide how to share pumpkin seeds fairly with a group of children.
<u>Egg Tower</u>	3-Act Task <i>Whole Group</i>	Multiplication and Arrays	MGSE3.OA.1	In this task, students will view a picture and tell what they noticed. Next, they will be asked to discuss what they wonder about or are curious about. Students will then use mathematics to answer their own questions.
<u>Array-ning Fact Families</u>	Practice Task <i>Individual/Partners</i>	Multiplication and Division	MGSE3.OA.5 MGSE3.OA.6	In this task, students will make models on grid paper of arrays that show both multiplication and division number sentences.
<u>Finding Factors</u>	Constructing/Practice Task <i>Small Group/Partners</i>	Multiplication and Division	MGSE3.OA.5 MGSE3.OA.6 MGSE3.OA.7	This is a several part task in which students find factors through work with multiplication and division.
<u>Shake, Rattle, and Roll Revisited</u>	Practice Task <i>Individual/Partners</i>	Multiplication	MGSE3.OA.1 MGSE3.OA.2	In this task, students will roll two cubes to get factors and use factors to find the product.
<u>Use What You Know</u>	Practice Task <i>Individual/Partner</i>	Unknown Factors	MGSE3.OA.6	In this task, students use multiplication facts and strategies to identify the unknown factor in a division problem.

Georgia Department of Education
 Georgia Standards of Excellence Framework
GSE The Relationship Between Multiplication and Division • Unit #2

Multiplication Chart Mastery	Practice Task <i>Individual/Small Group</i>	Multiplication Chart	MGSE3.OA.5 MGSE3.OA.6 MGSE3.OA.7	In this task, students will explain and describe the patterns they find in the multiplication chart. This task would work well as a math conference interview.
Making the “Hard” Facts Easy	Constructing Task <i>Small Group/Partners</i>	Distributive Property of Multiplication	MGSE3.OA.5 MGSE3.OA.7	In this task, students will practice using the distributive property.
Find the Unknown Number	Practice Task <i>Individual/Partners</i>	Unknown Factors	MGSE3.OA.5 MGSE3.OA.6 MGSE3.OA.7	In this task, students will complete division equations by finding the unknown factors.
Making Up Multiplication	Constructing Task <i>Individual/Partners</i>	Multiplication Stories	MGSE3.OA.5 MGSE3.OA.6	In this task, students will learn three different ways a multiplication problem can be written. They will then practice writing their own problems.
Field Day Blunder	Constructing Task <i>Partners</i>	Multiplication	MGSE3.OA.3 MGSE3.OA.4	In this task, students will complete a multi-step word problem.
Leap Frog	Constructing Task <i>Individual/Partners</i>	Line Plot Graph	MGSE3.MD.4	In this task, students will measure the leaps of origami frogs to the nearest inch and plot the measurement on a line plot graph.
Our Favorite Candy	Constructing Task <i>Individual/Partners</i>	Pictograph and Bar Graph	MGSE3.MD.3	In this task, students will collect data based their favorite candy.
My Special Day	Culminating Task <i>Individual</i>	Multiplication, Division, and Data	MGSE3.OA.5 MGSE3.OA.6 MGSE3.OA.7	In this task, students will plan a party under \$100.
Ice Cream Scoops	Culminating Task <i>Individual</i>	Multiplication and Division	MGSE3.OA.1 MGSE3.OA.2 MGSE3.OA.3 MGSE3.OA.4 MGSE3.MD.3	In this culminating task, students will use multiplication and division to show different ways they can spend \$2.00 on different flavors of ice cream.

SCAFFOLDING TASK: ONE HUNDRED HUNGRY ANTS!

In this task, students will determine the factors of a product by creating equal groups of counters/colored tiles.



CONTENT STANDARDS

MGSE3.OA.1. Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5×7 .*

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

This standard interprets products of whole numbers. Students recognize multiplication as a means to determine the total number of objects when there are a specific number of groups with the same number of objects in each group. Multiplication requires students to think in terms of groups of things rather than individual things. Students learn that the multiplication symbol ‘x’ means “groups of” and problems such as 5×7 refer to 5 groups of 7.

Example: Jim purchased 5 packages of muffins. Each package contained 3 muffins. How many muffins did Jim purchase? (5 groups of 3, $5 \times 3 = 15$)

Describe another situation where there would be 5 groups of 3 or 5×3 .

COMMON MISCONCEPTIONS

A major conceptual hurdle in working with multiplicative structure is understanding groups of items as single entities while also understanding that a group contains a given number of objects (Clark & Kamii, 1996). Students can solve the problem “How many apples are in 4 baskets of 8 apples each?” by counting out four sets of eight counters and then counting them all. To think multiplicatively about this problem as four sets of eight requires students to conceptualize each group of eight as a single item to be counted. Experiences with making and counting equal

groups, especially in contextual situations, are extremely useful. (From: Van de Walle, *Teaching Student-Centered Mathematics*, Vol. II 3-5, page 111)

ESSENTIAL QUESTIONS

- How can multiplication be represented?
- How does an array represent the meaning of multiplication?

MATERIALS

- Colored tiles or two-sided counters
- Linking cubes (100 for groups of 4)
- Something to help organize groups such as paper plates, cups, bowls, etc.
- *One Hundred Hungry Ants*, by Elinor J. Pinczes or similar story
- Math Journal

GROUPING

Individual/Partners

NUMBER TALK

In the third grade overview, the importance of giving students opportunities to mentally compute and explain computational strategies is discussed. *Number Talks* is an excellent way to do this. Between 5 and 15 minutes should be dedicated daily to students sharing the authority of determining whether answers are accurate. Students are expected to think through all solutions and strategies carefully (Parrish, 2010). During the *Number Talk*, the teacher is not the definitive authority. The teacher is the facilitator and is listening for and learning from the students' natural mathematical thinking. The teacher writes a problem horizontally on the board in whole group or a small setting. Students mentally solve the problem and share with the whole group HOW they derived the answer. They must justify and defend their reasoning. The teacher simply records the students thinking and poses extended questions to draw out deeper understanding for all. The effectiveness of numbers talks also has a lot to do with the routines and environment that is established. Students must be given time to think quietly without the pressure of their peers. To develop this, the teacher should establish a signal of some sort to identify that one has a strategy to share. One way to do this is to place a finger on their chest indicating that they have one strategy to share. If they have two strategies to share, they place two fingers out on their chest and so on. The following number strings involve repeated addition, which will introduce students to the concept of multiplication being addressed throughout this unit.

$50 + 50$	$25 + 25 + 25 + 25$	$20 + 20 + 20 + 20 + 20$
$51 + 51$	$26 + 26 + 26 + 26$	$21 + 21 + 21 + 21 + 21$

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task students determine factors of a product by creating equal groups of counters/colored tiles.

Part I (SMP 1, 2, 3, 4, 5, 6, 7, and 8)

Begin the lesson by reading *One Hundred Hungry Ants*, by Elinor J. Pinczes or similar story. Discuss the ways the ants reorganized themselves into equal groups. You can begin the discussion by asking the following question: When the ants were first interrupted, how did they arrange themselves? Provide groups of 4 with 100 linking cubes and let them investigate this idea. Have the students create the model with linking cubes. Write the multiplication sentence next to the model. Ask students to explain the factors, by asking “Which number represents which part of the model?” At this point the discussion will develop around groups and how many are in the groups. Continue discussing and modeling the arrangements that the ants are put into each time they are interrupted. To emphasize the idea of equal groups, you may want to ask the students, “Why did the ants not organize into groups of 3 or 6?” Allow students time to struggle with this idea and to use linking cubes to investigate.

Part II (SMP 1, 4, 5, and 6)

After students have had discussions about the ways that the ants have organized themselves, they will have an opportunity to organize ants of their own. Students will be given 20 counters and asked to arrange them in as many different equal groups as they can. Students should record their reasoning using pictures, words, and numbers, in their math journal.

FORMATIVE ASSESSMENT QUESTIONS

- How many ways were you able to organize 20 ants?
- What does your number sentence look like?
- How can you explain your picture and number sentence in words?

DIFFERENTIATION

Extension

- Allow students to use different numbers of ants. (24, 36, 42). They should explain their reasoning using pictures, words, and numbers.

Intervention

- Allow students to work in small guided groups and reduce the number of ants to 12



SCAFFOLDING TASK: ARRAYS ON THE FARM

In this task the students use arrays to solve multiplication problems. Farmers grow their crops in arrays to make them easier to look after and to harvest. Additionally, students are asked to be involved in guessing and estimating. These are both useful skills that take time to develop. This task provides some practice for these skills.

APPROXIMATE TIME: 3-4 days

CONTENT STANDARDS

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.⁶ Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.) Use arrays, area models, and manipulatives to develop understanding of properties.

STANDARDS FOR MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

(Information quoted from Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades K-3, page 85)

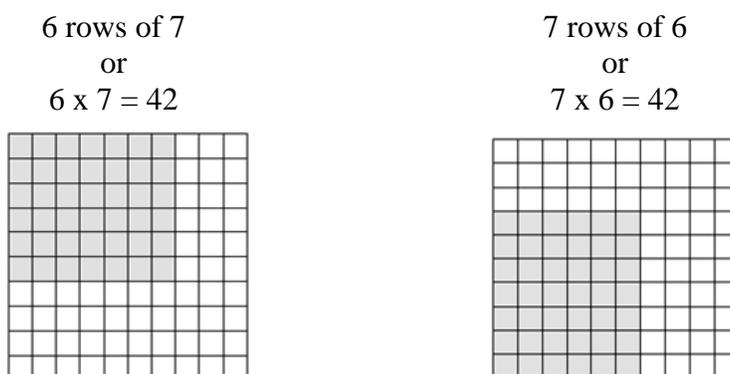
“It is not intuitively obvious that 3×8 is the same as 8×3 or that, in general, the order of the numbers makes no difference (the order or commutative property). A picture of 3 sets of 8 objects cannot immediately be seen as 8 piles of 3 objects. Eight hops of 3 land at 24, but it is not clear that 3 hops of 8 will land at the same point.

⁶ Students need not use formal terms for these properties.

The array, by contrast, is quite powerful in illustrating the order property, as shown in Figure 3.9. Children should draw or build arrays and use them to demonstrate why each array represents two different multiplications with the same product.”

Arrays provide a quick and efficient way to count things. For example, this can be done by adding the numbers in each row together. However, it is quickest to determine the number of objects in an array by multiplying the number in the width by the number in the height using area models.

This task provides different contexts to explore multiplication concepts using arrays such as the one below. This array is an area model.



COMMON MISCONCEPTIONS

One common misconception is that students must answer their problems using multiplication number sentences. Students may continue to use repeated addition equations to represent their work. It is important for teachers to use this time to relate multiplication to the student’s prior knowledge of repeated addition by introducing the multiplication sign and explaining what the two factors mean. (Taken from: Van de Walle, *Teaching Student-Centered Mathematics*, Vol. II 3-5)

ESSENTIAL QUESTIONS

- How can multiplication be represented?
- How does an array represent the meaning of multiplication?

MATERIALS

- Counter or small manipulatives
- Large pieces of paper for recording
- scissors

- Henry’s Array Farm recording sheet
- Array Circles recording sheet
- Enlarged Small Station Task problems
- Station Task problems individual recording sheet

GROUPING

Partner/Small Group

NUMBER TALK

As discussed in the beginning lesson of this unit, Number Talks give students opportunities to mentally compute and explain computational strategies. The problems are ordered so that the strategy involved in solving each problem can be used to solve the next one.

2×4

4×4

2×5

4×5

4×7

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION (SMP 1, 2, 3, 4, 5, 6, 7, and 8)

Part I Scaffolding

1. Begin the task with the “Farmer’s Problem”

Pose the problem:

Henry’s farm produces potatoes every fall. He has 36 potato plants. How could Henry arrange his plants into equal rows and columns?

Provide a pile of counters on an overhead, use a smart board with a shape tool (or plant image), or ask volunteers to come and show what the first row of plants might look like.

Is there only one way to arrange Henry’s potato plants?

It’s important for the students to understand what a row is so they can make sense of the problem.

What are some predictions? How many different strategies will Henry be able to choose from? Record predictions on the board or someplace the class can see.

2. Arrange the class into small mixed ability groups with 3 or 4 students in each. Give each group a large sheet of paper. Ask them to fold their piece of paper so it makes 4 boxes.

Georgia Department of Education
 Georgia Standards of Excellence Framework
 GSE The Relationship Between Multiplication and Division • Unit #2

Strategy 2	Strategy 4
Strategy 1	Strategy 3

Allow some time for each group to see if they can come up with 4 different ways to solve the Farmer’s Problem and record their method in the 4 boxes.

The teacher should circulate to prompt groups and challenge their thinking.

Ask: Are there more efficient ways to determine how many plants there are without having to count each one?

3. Ask the groups to cut their large sheet into the 4 boxes. Each student will take a different strategy from their group. They must be aware that they will explain the strategy and ready to do so. Gather the class in a circle or position them so each one can see the presenting student and strategy. Ask the groups to share what they think is their most interesting strategy. Place each group’s strategy in the middle of the circle or area as they are being shared. Once each group has contributed, ask the students to offer strategies that no one has shared yet.

Likely strategies	Possible teacher responses
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	Can you think of a quicker way to work out how many plants there are? How many plants are there in one row?
6,12,18,24,30,36	Do you know what $6 + 6 = ?$ Can that help you solve this problem quicker?
$6 \times 6 = 36$	What if Henry had 9 rows of plants and there were 8 plants in each row?
$6 + 6 = 12$; $12 + 12 = 24$; $24 + 12 = 36$	You used adding to work that out. How could you have used multiplication?
$2 \times 6 = 12$; $12 + 12 + 12 = 36$	If $2 \times 6 = 12$, what does $3 \times 6 = ?$ How could you work out 6×6 from this?
$3 \times 6 = 18$ and then doubled it $5 \times 6 = 30$; and 6 more = 36	Awesome, clever you, could you work out 9 rows of 6 for me?

4. The shared strategies can be put into similar groups.

Ask: *Who used a strategy like this one? Show Henry's Array Farm Format sheet. How do you think we could use this to solve Henry's problem?* Send groups off to experiment with Henry's Array Farm Format sheet. Again circulate in the classroom and observe what the groups are doing.

5. As a class, share the different ways that students used the array to solve Henry's Farm problem.
6. Challenge the students to use the array in the same way as another group did and pose the following problems.
7. Review predictions made before breaking up into small groups? Which predications were most reasonable?

<i>Henry plants 2 more rows of 6 potato plants. How many rows does he have all together now? How many plants is that all together?</i>	<i>Henry's sister, Katie has a farm exactly the same size with the same amount of plants. How many plants do they have all together?</i>
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Part II Constructing

Before the students work on small group tasks, you will need to prepare the material from Henry's Array Farm recording sheet, Array Circles sheet and Station Task sheets.

The next few days will involve working on similar problems. Allow students the opportunity to choose intervention, if they are finding the problems challenging and are unable to get started independently. This is an opportunity for the teacher to go over more examples and clarify any misunderstandings.

Begin by role playing the Airplane Rides Over the Farm problem from the Station Task sheet to get the students started. Ask 6 students to pretend to be the passengers on the plane. Ask them to bring their chair to the front and sit in a row. Leave a gap in the middle to show where the aisle is. Then choose a second group of 6 to make a second row behind the first row of 6 students.

Ask students to think about:

How many passengers would there be if there were 4 rows of 6?

What about if there were 9 rows?

Encourage students to share and demonstrate their strategies.

Place the enlarged Station Task problem cards at each station with Henry's Array Farm, Circle Array sheets and counters or small manipulatives. (You may want to have multiple stations of

each problem depending on your class size. Make sure the Station Task number is large, so when students are ready to move they can identify an open station easily)

Read the Station Tasks to the class one at a time to clarify any misunderstandings.

Explain the Station Task Recording Sheet and how it is used. (As students have finished a Station Task, they complete the tracking box and continue to the next problem. Encourage students to show their math language, working knowledge and solutions on this sheet.)

Set/remind students of classroom procedures for partner work.

Assign the partners and allow students to choose which Station Task to solve first. Spend the session circulating the stations and questioning students.

How many did you think there would be to start with?

Why did you predict that to start with?

What gave you a clue to make that prediction?

Can you think of another way to use the array to solve that problem?

Can you think of a way to solve the problem without using the array?

Which way do you think is faster? Why?

Georgia Department of Education
Georgia Standards of Excellence Framework
GSE The Relationship Between Multiplication and Division • Unit #2

Task Station 1 (have counters, Henry’s Array Farm and array circles available)

<p>Peanut Farm (Part 1)</p> <p>Paul has a peanut farm with 6 plants in each row and there are 8 rows of plants. How many plants does he have in all?</p> <p>Prediction</p> <p>Solution</p>	<p>Peanut Farm (Part 2)</p> <p>Paul wants to plant another field of peanut plants. He can get 24 plants at a cheap price. How many different ways can he plant these peanut plants? How many rows should he plant?</p> <p>How many peanut plants should be in each row?</p> <p>Show all the different ways Paul could plant his peanut plants in rows by making your own array on a blank piece of paper.</p>
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Task Station 2 (have counters or manipulatives available)

<p>Onion Farm (Part 1)</p> <p>Bill has an onion farm. Bill has 4 onion plants in each row and has 4 rows. Bill has a total of 3 fields the same size. How many onion plants are there on his farm?</p> <p>Prediction</p> <p>Solution</p>	<p>Onion Farm (part 2)</p> <p>Bill’s son has just bought the plants to start his own onion farm. He has purchased 36 plants and wants some help on how to arrange the plants into rows. What suggestions would you give Bill’s son?</p> <p>Draw all the possibilities</p>
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Task Station 3

<p>Watermelon Farm (Part 1)</p> <p>Wanda has a watermelon farm. In each row she has 12 watermelon plants and there are 4 rows. How many watermelon plants does she have in all?</p> <p>Prediction</p> <p>Solution</p>	<p>Watermelon Farm (Part 2)</p> <p>Wanda wants to double the size of her watermelon farm each year. How many plants will she have in all after?</p> <p>1 year</p> <p>2 years</p> <p>3 years</p> <p>Record your strategies on an array</p>
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Task Station 4

<p>Airplane Rides Over the Farm</p> <p>Henry is giving airplane rides over his farm. His plane has 6 seats in each row. The seat row numbers go up to 21. How many passengers can Henry’s plane hold?</p> <p>Prediction</p> <p>Solution</p>	<p>Airplane Rides Over the Farm</p> <p>Henry’s plane makes 2 trips over the farm each day. If the plane was full each time, how many passengers would get to see Henry’s farm from the airplane?</p> <p>Prediction</p> <p>Solution</p>
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At the end of each session allow for a sharing time to discuss what students were finding interesting and challenging. Share some strategies used.

Part III

Conclusion/Reflection

On the final day of the task, ask the students to make up their own multiplication problems for their partner to solve.

Set the problem: Tell the students they are going to pretend to be tomato growers. They are to decide how many rows of tomato plants they want in each row and how many rows they will have altogether.

Now they challenge their partner to see if the partner can work out how many tomato plants they will have altogether. Ask for volunteers to share their problems and the partner share what strategy they used to solve the problem.

Challenge the students to make up 2 more problems for their partner. Suggest that they solve the problem using an array.

Conclude the lesson by talking about the types of problems we have explored and solved over the past few days. They were doing multiplication problems! Let them know there are many ways of solving these problems and that the array is just one of these ways.

FORMATIVE ASSESSMENT QUESTIONS

- What are two strategies you used to solve the problems?
- How can the same problem be represented by two different arrays?
- How does an array model show repeated addition?
- Can you think of a more efficient way to work out how many _____ there are?
- How many _____ are there in one row?
- What if _____ had 9 rows of _____ and there were 8 _____ in each row?
- You used adding to work that out. How could you have used multiplication?
- If $2 \times 6 = 12$, what does $3 \times 6 = ?$ How could you work out 6×6 from this?
- Awesome, clever you, could you work out 9 rows of 6 for me?

DIFFERENTIATION

Extension

- Replace Station Task amounts with greater numbers.

Georgia Department of Education
Georgia Standards of Excellence Framework
GSE The Relationship Between Multiplication and Division • Unit #2

- Provide larger numbers and challenge the students to create as many possible arrays as they can for each farm

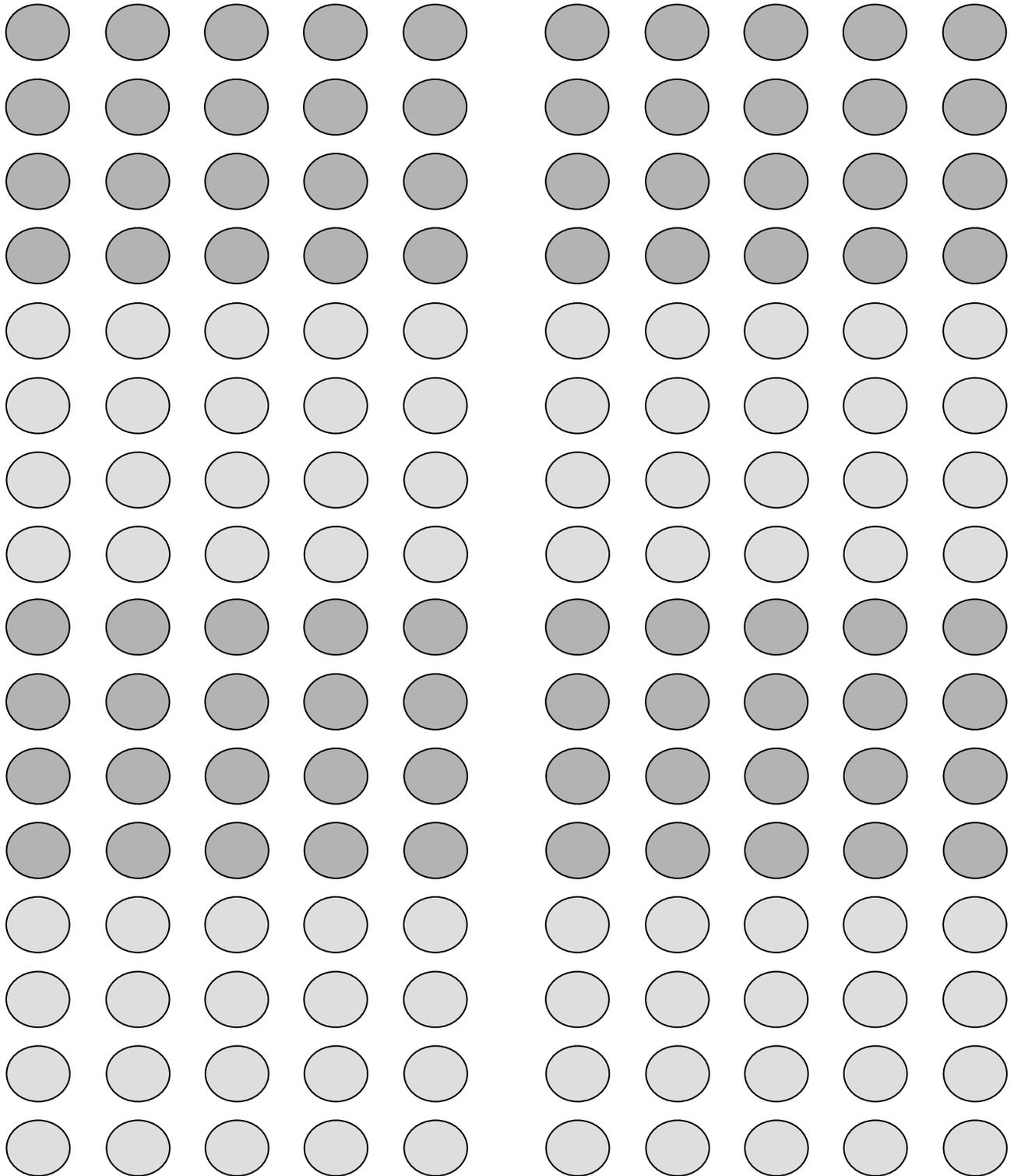
Intervention

- Replace Station Tasks with lower amounts
- Provide Station Tasks with partial arrays that the student needs to complete

TECHNOLOGY CONNECTION

- <http://www.multiplication.com/>
This site contains practice games for multiplication facts as well as teacher resource pages with instructional ideas on how to introduce multiplication.
- http://www.haelmedia.com/OnlineActivities_txh/mc_txh3_002.html
This site allows students to make arrays and see the associated facts.

Array of Circles



Arrays on the Farm: Task Station Cards (enlarge)

Peanut Farm (Part 1)



Paul has a peanut farm with 6 plants in each row and there are 8 rows of plants. How many plants does he have in all?

Prediction

Solution

Peanut Farm (part 2)



Paul wants to plant another field of peanut plants. He can get 24 plants at a cheap price. How many different ways can he plant these peanut plants? How many rows should he plant?

How many peanut plants should be in each row?

Show all the different ways Paul could plant his peanut plants in rows by making your own array on a blank piece of paper.

Onion Farm (Part 1)



Bill has an onion farm. Bill has 4 onion plants in each row and has 4 rows. Bill has a total of 3 fields the same size. How many onion plants are there on his farm?

Prediction

Solution

Onion Farm (part 2)



Bill's son has just bought the plants to start his own onion farm. He has purchased 36 plants and wants some help on how to arrange the plants into rows. What suggestions would you give Bill's son?

Draw all the possibilities

Watermelon Farm (Part 1) 

Wanda has a watermelon farm. In each row she has 12 watermelon plants and there are 4 rows. How many watermelon plants does she have in all?

Prediction

Solution

Watermelon Farm (Part 2) 

Wanda wants to double the size of her watermelon farm each year. How many plants will she have in all after...

1 year

2 years

3 years

Record your strategies on an array

Airplane Rides Over the Farm

(Part 1) 

Henry is giving airplane rides over his farm. His plane has 6 seats in each row. The seat row numbers go up to 21. How many passengers can Henry's plane hold?

Prediction

Solution

Airplane Rides Over the Farm

(Part 2) 

Henry's plane makes 2 trips over the farm each day. If the plane was full each time, how many passengers would get to see Henry's farm from the airplane?

Prediction

Solution

Name _____

Arrays on the Farm

Student Recording Sheet

I. Station Tasks

Stations	Initial when Completed
Peanut Farm	
Onion Farm	
Watermelon Farm	
Delta's New Plane	

Peanut Farm (part 1)

Paul has a peanut farm with 6 plants in each row and there are 8 rows of plants. How many plants does he have in all?



Prediction:

Show your math language and work to find the answer here

Peanut Farm (part 2)

Paul wants to plant another field of peanut plants. He can get 24 plants at a cheap price. How many different ways can he plant these peanut plants? How many rows should he plant?

How many peanut plants should be in each row?

Draw all the different ways Paul could plant his peanut plants in rows by making arrays.



Onion Farm (Part 1)

Bill has an onion farm. Bill has 4 onion plants in each row and has 4 rows. Bill has a total of 3 fields the same size. How many onion plants are there on his farm?



Prediction

Show your math language and work to find the answer here.

Onion Farm (part 2)

Bill's son has just bought the plants to start his own onion farm. He has purchased 36 plants and wants some help on how to arrange the plants into rows. What suggestions would you give Bill's son?

Draw all the possible arrays Bill could use to organize his plants.



Watermelon Farm (Part 1)

Wanda has a watermelon farm. In each row she has 12 watermelon plants and there are 4 rows. How many watermelon plants does she have in all?



Prediction

Show your math language and work to find the answer here

Watermelon Farm (Part 2)

Wanda wants to double the size of her watermelon farm each year. How many plants will she have in all after 1 year, after 2 years, after 3 years? .

Record your strategies on an array

1 year



2 years

3 years

Airplane Rides Over the Farm (Part 1)

Henry is giving airplane rides over his farm. His plane has 6 seats in each row. The seat row numbers go up to 21. How many passengers can Henry's plane hold?

Prediction



Show your math language and work to find the answer here

Airplane Rides Over the Farm (Part 2)



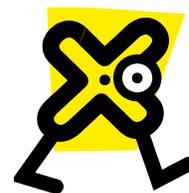
Henry's plane makes 2 trips over the farm each day. If the plane was full each time, how many passengers would get to see Henry's farm from the airplane?

Prediction

Show your math language and work to find the answer here

SCAFFOLDING TASK: WHAT'S MY PRODUCT?

This task allows students to interpret products of whole numbers by creating equal groups with manipulatives.



APPROXIMATE TIME: 1 class session

CONTENT STANDARDS

MGSE3.OA.1. Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5×7 .*

STANDARDS FOR MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

BACKGROUND KNOWLEDGE

This standard interprets products of whole numbers. Students recognize multiplication as a means to determine the total number of objects when there are a specific number of groups with the same number of objects in each group. Multiplication requires students to think in terms of groups of things rather than individual things. Students learn that the multiplication symbol ‘x’ means “groups of” and problems such as 5×7 refer to 5 groups of 7.

Example: Jim purchased 5 packages of muffins. Each package contained 3 muffins. How many muffins did Jim purchase? (5 groups of 3, $5 \times 3 = 15$)

Describe another situation where there would be 5 groups of 3 or 5×3 .

COMMON MISCONCEPTIONS

Traditionally multiplication tables are emphasized when students begin learning about multiplication. Students are sent home with flash cards without a true understanding of what multiplication is. This way of learning multiplication can be difficult for students to understand. Naturally, students make groups and groups of groups. The creation of groups is a way to find the total of something in the most efficient way. The following activity allows students to build on their natural ability to form groups and learn multiplication without memorizing facts in isolation, but as number facts that can be related to each other in a multitude of ways (Frans van Galen and Catherine Twomey Fosnot, 2007, Context for Learning Mathematics).

ESSENTIAL QUESTIONS

- How can you interpret the product by making equal groups?
- What are different ways to multiply two factors to get the same product?

MATERIALS

- Colored tiles or two-sided counters
- Something to help organize groups such as paper plates, cups, bowls, etc.
- “What’s My Product” recording sheet

GROUPING

Individual/Partners

NUMBER TALK

As discussed in the beginning lesson of this unit, Number Talks give students opportunities to mentally compute and explain computational strategies. The problems are ordered so that the strategy involved in solving each problem can be used to solve the next one.

$$2 \times 3$$

$$4 \times 3$$

$$8 \times 3$$

$$3 \times 6$$

$$6 \times 6$$

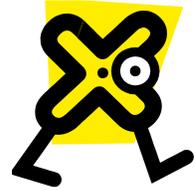
TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 4, 5, and 6)

Part I

Discuss with students how to group objects. Show a container of 20 counters. Discuss with students an easy way to count the total number of counters in the container. Have students arrange the counters into equal groups. As students discuss how to put the 20 counters into groups write their thinking on the board. Explain to students that in a multiplication problem one number represents the number of groups and the other number represents the number of objects in a group.

Part II

Provide students with a given set (over 50) of counters or tiles to separate into equal groups. The students will continue to rearrange tiles into different groupings that are equal. As each group is arranged, write a multiplication fact to match the arrangement. Students will record their thinking in the “What’s My Product?” recording Sheet.



FORMATIVE ASSESSMENT QUESTIONS

- How many ways were you able to organize the number of counters you were given?
- Can you think of another way to organize your counters?
- How can you explain your picture and number sentence in words?

DIFFERENTIATION

Extension

Give students a prime number of counters (29, 31, 47, etc.) and charge students with counting the number of counters through grouping. They cannot count/group by ones! Even though prime numbers are not a third grade standard, the purpose of this extension is for students to create equal groups with an amount “left over”. Students can then count by the groups created and add the left over amount to reach the prime number.

Intervention

Provide smaller numbers of counters and allow students to work with a partner.

Name _____

Date _____

What's My Product?

Directions: Arrange counters into equal groups. Complete the table below with your arrangements.

Groups	# of Tiles/Counters in Each Group	Multiplication Fact	Total



SCAFFOLDING TASK: THE DOORBELL RANG

In this task, students will be introduced to division.

CONTENT STANDARDS

MGSE3.OA.2 Interpret whole number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares (How many in each group?), or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each (How many groups can you make?). For example, describe a context in which a number of shares or a number of groups can be expressed as $56 \div 8$.

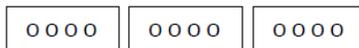
STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

This standard focuses on two distinct models of division. Students should begin to master multiplication facts in connection with division: partition models and measurement (repeated subtraction) models.

Partition models focus on facts. When we are trying to determine the question, “How many in each group?” a context problem for partition models would be: There are 12 cookies on the counter. If you are sharing the cookies equally among three bags, how many cookies will go in each bag?



Measurement (repeated subtraction) models focus on the question, “How many groups can you make?” A context problem for measurement models would be: There are 12 cookies on the counter. If you put 3 cookies in each bag, how many bags will you fill?



Students often think 9 times what number is 36? It is not a separate fact but closely tied together compounding the difficulty of division notation as the unfortunate phrase “goes in to” as in, “6 goes in to 24.” This phrase carries little meaning about division, especially in connection with a fair-sharing or partitioning context. The “goes in to” terminology is simply engrained in adult

parlance and has not been in textbooks for years. Instead of this phrase, you can use appropriate terminology with students, such as “How many groups of 6 are in 24?” (Teaching *Student-Centered Mathematics* Vol. II, 3-5, page 113, John A. Van de Walle and LouAnn H. Lovin, 2006).

COMMON MISCONCEPTIONS

Students may have difficulty seeing multiplication and division as inverse operations. In order to develop an understanding of this relationship, students need to have ample opportunities to explore these two operations simultaneously.

ESSENTIAL QUESTIONS

- What strategies can be used to solve real world division problems?
- In what ways can division be represented?
- How are multiplication and division alike and different?

MATERIALS

- *The Doorbell Rang* by Pat Hutchins
- 12 cookie cut-outs for each student(see attached page)
- Student “Division Patterns” recording sheet- “The Doorbell Rang”

GROUPING

Individual/Small Group Task

NUMBER TALK

As discussed in the beginning lesson of this unit, Number Talks give students opportunities to mentally compute and explain computational strategies. The problems are ordered so that the strategy involved in solving each problem can be used to solve the next one.

1 x 24
2 x 12
4 x 6
8 x 3
24 x 1

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2, 3, 4, 5, 6, and 8)

In this task, students will analyze patterns in division.

Part I (Individual Task)

Begin this task by reading and discussing, the events in *The Doorbell Rang* by Pat Hutchins . *The Doorbell Rang* is a story about dividing a batch of cookies by a varying number of children. Give each child 12 cut out cookies to use during the story to create the different multiplication and division number sentences. Focus on how the number of cookies each child gets changes as the number of children increases.

Once the book has been read and all students have manipulated the cookies to create each situation in the story, read the book again. This time, instead of focusing on the representation, use mathematical terminology to describe what is happening in the story. For example, Mom made 12 cookies that were divided among 3 people. How many cookies did each person get? Then, write the division sentence on the board to start a discussion about what each number represents in regards to both the whole and the equal groups.

Part II (Groups of 3 or 4)

Have students continue to use their cookies to answer the questions on the student recording sheet.

Read each problem. Use your group’s cookies to help find the answer. Write the division number sentence for each one.

1. Sam’s mom baked 15 cookies. Sam, Charlie, and Henry shared the cookies. If the three boys shared the cookies equally, how many cookies did each boy receive?
2. Two girls want to share a batch of cookies. They baked 18 cookies. If the girls share them equally, how many cookies will each girl get?
3. Lilly wants to invite some friends over to eat cookies. She has 24 cookies and wants everyone to get 3 cookies. How many friends can she invite if she is not going to eat any cookies?
4. Alex baked 48 cookies for Halloween. He put 3 cookies in each bag. How many bags can he make?

Once all groups have completed the task, hold a class discussion and allow all groups to explain their strategies for solving each division problem.

FORMATIVE ASSESSMENT QUESTIONS

- How did you sort your cookies?
- What is a multiplication fact that could help you solve the problem?
- If you drew a picture to match this problem, what would it look like?

DIFFERENTIATION

Extension

Students may write their own division problem, using cookies as the context of the problem.

Intervention

Use plates, index cards, etc. (any visual representation) to help students form groups to count cookies into.

TECHNOLOGY CONNECTION

- <http://mcq.wrdsb.on.ca/Admin/Documents/WORC/PDFs/LESSON%20PrimaryMath.pdf>
- <http://www.lessonplanspage.com/MathLAMultiplicationDivisionUsingTheDoorbellRang23.htm>
Both websites above provide teacher resources for the book *The Doorbell Rang* by Pat Hutchins.
- http://www.softschools.com/math/games/division_practice.jsp
This site allows for practice with division. The student or teacher can determine the parameters for the divisor, dividend, and number of problems



The Doorbell Rang

Directions: Read each problem. Use your group's cookies to help find the answer. Write the division number sentence for each one.

1. Sam's mom baked 15 cookies. Sam, Charlie, and Henry shared the cookies. If the three boys shared the cookies equally, how many cookies did each boy receive?
2. Two girls want to share a batch of cookies. They baked 18 cookies. If the girls share them equally, how many cookies will each girl get?
3. Lilly wants to invite some friends over to eat cookies. She has 24 cookies and wants everyone to get 3 cookies. How many friends can she invite if she is not going to eat any cookies?
4. Alex baked 48 cookies for Halloween. He put 3 cookies in each bag. How many bags can he make?

CONSTRUCTION TASK: FAMILY REUNION

This task is a two part task. Part I introduces and scaffolds learning of the associative property. In Part II students will be constructing the associative property.



APPROXIMATE TIME: 1-2 class sessions

CONTENT STANDARDS

Understand properties of multiplication and the relationship between multiplication and division.

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.⁷ Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.)
***Use arrays, area models, and manipulatives to develop understanding of properties.

MGSE3.OA.6. Understand division as an unknown-factor problem. For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8.
***Conversations should also include connections between division and subtraction.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

(Information from Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades 3-5, page 61)

Students need a good understanding of how to manipulate pattern blocks in order to solve tasks. Students should have had prior experiences with the manipulatives; they should be aware of how to use the blocks as a tool for problem solving. Emphasize the connection between multiplication and division in these tasks. Students should also have an understanding of what to do with

⁷ Students need not use formal terms of these properties.

remainders. Sometimes remainders can be discarded, could force the number to the next highest whole, or rounded to the next whole for an approximate answer. In this activity they may experience someone being left out. Students need to understand how the remainder will be handled. In the case of seating, the students will have to force the number to the next whole.

COMMON MISCONCEPTION

Students may have difficulty seeing multiplication and division as inverse operations. In order to develop an understanding of this relationship, students need to have ample opportunities to explore these two operations simultaneously.

ESSENTIAL QUESTIONS

- How is the associative property of multiplication used in solving a problem?
- How can multiplication and division be used to solve real world problems?
- How can we use patterns to solve problems?

MATERIALS

- Item cards for Part I (printed on three different color paper or write them on three different colors of index cards)
- “Family Reunion” recording sheet
- Pattern Blocks

GROUPING

Individual/Partner Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007)).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2, 3, 4, 6, 7 and 8)

This task will be in two parts: Part I introduces and scaffolds learning the Associative Property. In Part II students will be constructing the associative property.

Part I (Groups of 3)

Problem: There are 36 people at a family reunion. You have to pack coolers with the same number of food items in each cooler.

1. Start by giving each group of students a cooler card, food item card, and a package card. They are to determine, using multiplication, if they will have too much, not enough, or the right amount (36) of food. For example, 2 coolers x 5 packages x 8 hot dogs in a package = 80 hotdogs. This group has too much food.

2. Challenge the groups of three to see if they can get a different product by switching places. Ask them if it matters what position they are in? Students can record the number sentences and products either on chart paper, smart board or math notebook. Allow time for students to determine what the best equation will be for each food group. Discuss the findings and how they figured out the different amounts. Discuss the associative property and how it will affect the product when multiplying three integers.

Part II

Students will use models of tables to decide how many tables must be used to seat a given number of guests.

Students will follow the directions below from the “Family Reunion” recording sheet.

1. Help set up tables for your upcoming family reunion. Thirty-six relatives need a place at a table to sit and enjoy their food and drinks. You may use the following table styles:
 - Square tables that seat one person to a side for a total of four people at a square table.
 - Circular bistro tables that seat exactly three people.
 - Hexagonal tables that seat one person to a side for a total of 6 people.
 - Rectangular tables that seat twelve people.
 - Pentagonal tables that seat one person to a side for a total of five people.
2. Which table would you need the most? Show how you figured out how many of those tables you would need.
3. Which table would you need the least? Show how you know.
4. Choose two types of tables and draw your method for seating all 36 relatives for the family reunion. Write a number sentence to describe what you’ve drawn.
5. Suppose the only tables you had were pentagonal. Explain how you would seat all of your relatives.

FORMATIVE ASSESSMENT QUESTIONS

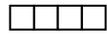
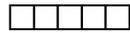
- What combinations of tables have you tried so far?
- How will you know when you find the right combination?

- Do you think there is more than one right solution for this task? Why do you think so? Do you have a way of finding out?
- How many _____ (square, circular, hexagonal, rectangular, or pentagonal) tables do you need? How do you know?

DIFFERENTIATION

Extension

- Use square tables that seat one person to a side, but this time push the tables together end to end and find out how many relatives can be seated. Continue adding tables this same way until you have enough tables to seat everyone. Enter the information in a table and describe any patterns you see. How many square tables pushed end to end would it take?

# Tables	# People Seated	Sketch	Number Pattern
1	4		$(1 \times 4) - 0 = 4$ $(1 \times 2) + 2 = 4$
2	6		$(2 \times 4) - 2 = 6$ $(2 \times 2) + 2 = 6$
3	8		$(3 \times 4) - 4 = 8$ ← $(3 \times 2) + 2 = 8$
4	10		$(4 \times 4) - 6 = 10$ $(4 \times 2) + 2 = 10$ ←
5	12		$(4 \times 5) - 8 = 12$ $(5 \times 2) + 2 = 12$
.			
.			
.			
17	36		$(17 \times 2) + 2 = 36$

Two possible number patterns are shown.
 — The first is the number of seats for the tables, minus the sides lost when tables are pushed together.
 — The second pattern is the number of seats along the top and bottom plus the seat at each end.

- Choose another pattern block shape and see if the same pattern holds as you push the tables together.
- Experiment to see if it will take more or less tables if a hole is left in the center or if all tables touch another table on all sides except the side where the guests will sit.
- Use a different number of relatives or allow students to make up additional types of tables (octagonal, rhomboidal, triangular, or trapezoidal).
- Rather than two types of tables, let students use three types that still yield seating for 36 people.

Intervention

- Use a smaller number of relatives, such as 12 or 20.

- Guided practice that simulates the task, done ahead of time, will enable students to develop problem solving strategies, particularly if the teacher models the strategies students are developing.

TECHNOLOGY CONNECTION

- http://www.arcytech.org/java/patterns/patterns_d.shtml
This site allows students to work with pattern blocks in an interactive applet and easily print their work.

Item cards for Part I

1 package	2 packages
3 packages	4 packages
5 packages	6 packages
7 packages	8 packages

9 packages	10 packages
1 cooler	2 coolers
3 coolers	4 coolers
5 coolers	6 coolers
7 coolers	8 coolers

9 coolers	10 coolers
-----------	------------

Hamburgers (8 in a package)	Hamburger Buns (4 in a package)
--------------------------------	------------------------------------

Hot Dogs (7 in a package)	Hog Dog Buns (3 in a package)
------------------------------	----------------------------------

Bag of Individual Chips (5 in a package)	Juice Drinks (10 in a package)
--	-----------------------------------

<p style="text-align: center;">Sodas (6 in a package)</p>	<p style="text-align: center;">Ice Pops (9 in a package)</p>
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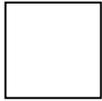


Name _____

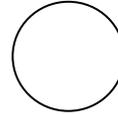
Date _____

Family Reunion

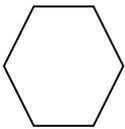
1. Help set up tables for your upcoming family reunion. Thirty-six relatives need a place at a table to sit and enjoy their food and drinks. You may use the following table styles:



Square tables that seat one person to a side for a total of four people at a square table



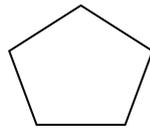
Circular bistro tables that seat exactly three people



Hexagonal tables that seat one person to a side for a total of 6 people



Rectangular tables that seat twelve people



Pentagonal tables that seat one person to a side for a total of five people

2. Of which table would you need the most? Show how you figured out how many of those tables you would need.
3. Of which table would you need the least? Show how you know.
4. Choose two types of tables and draw your method for seating all 36 relatives for the family reunion. Write a number sentence to describe what you've drawn.
5. Suppose the only had pentagonal tables that seat five people per table. Explain how you would seat all of your relatives.

CONSTRUCTING TASK: SKITTLE CUPCAKE COMBOS

This task assesses students' understanding of division and their ability to organize data.

CONTENT STANDARDS

MGSE3.OA.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.⁸ See Glossary: Multiplication and Division within 100.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning

BACKGROUND KNOWLEDGE

When students are given trivial word problems, they often just ask themselves what operation is called for; the context becomes irrelevant as they manipulate numbers, applying what they know. True context keeps students focused and interested in making sense of the math. Students begin to notice patterns and ask questions about what is going in the problem. Then students begin to defend their math to one another. The following activity allows students to build on their knowledge of grouping materials in order to divide more efficiently. (Frans van Galen and Catherine Twomey Fosnot, 2007, Context for Learning Mathematics).

COMMON MISCONCEPTION

Students may have difficulty seeing multiplication and division as inverse operations. In order to develop an understanding of this relationship, students need to have ample opportunities to explore these two operations simultaneously.

ESSENTIAL QUESTIONS

- How are multiplication and division related?

⁸ See glossary, Table 2.

MATERIALS

- paper
- graph paper
- counters, interlocking cubes

GROUPING

Individual/Partner Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2, 3, 4, 6, and 8)

Students will follow directions from the “Skittles Cupcake Combo” recording sheet.

I love Skittles and cupcakes! I decided to bake some cupcakes. I put a bag of Skittles, 45 in all, into my batter and baked a dozen cupcakes. Each cupcake had at least three Skittles and no more than five. What are the different possible combinations of Skittles found in each of the cupcakes?

FORMATIVE ASSESSMENT QUESTIONS

- What combinations of blocks have you tried so far?
- How will you know when you find the right combination?
- Do you think there is more than one right solution for this task? Why do you think so? Do you have a way of finding out?

DIFFERENTIATION

Extension

- Replace 45 with 50, 75, 90 for students who can work with larger numbers.

Intervention

- Replace 45 with a smaller number such as 12, 24, or 36. Model this task or a similar one in a small group setting.
- Use manipulatives to create 12 groups that would add to 45.



Name _____

Date _____

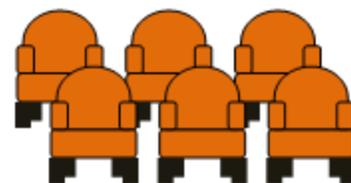
Skittles Cupcake Combos

I love Skittles and cupcakes! I decided to bake some cupcakes. I put a bag of Skittles, 45 in all, into my batter and baked a dozen cupcakes. Each cupcake had at least three Skittles and no more than five. What are the different possible combinations of Skittles found in each of the cupcakes?

1. Draw pictures to show all the ways you can arrange the Skittles.
2. Label and write matching number sentences for each arrangement.

CONSTRUCTING TASK: SEATING ARRANGMENTS

In this task, students will solve a word problem requiring them to make arrays using the number 24.



APPROXIMATE TIME: 1 class session

CONTENT STANDARDS

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.⁹ Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.)
***Use arrays, area models, and manipulatives to develop understanding of properties.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

(Information quoted from Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades 3-5, page 62)

“In the beginning, students will be able to use the same models – sets and number lines – for all four operations. A model not generally used for addition but extremely important and widely used for multiplication and division is the array. An array is any arrangement of things in rows and columns, such as a rectangle of square tiles or blocks.

To make clear the connection to addition, early multiplication activities should also include writing an addition sentence for the same model.”

⁹ Students need not use formal terms for these properties.

COMMON MISCONCEPTIONS

Traditionally multiplication tables are emphasized when students begin learning about multiplication. Students are sent home with flash cards without a true understanding of what multiplication is. This way of learning multiplication can be difficult for students to understand. Naturally, students make groups and groups of groups. The creation of groups is a way to find the total of something in the most efficient way. The following activity allows students to build on their natural ability to form groups and learn multiplication without memorizing facts in isolation, but as number facts that can be related to each other in a multitude of ways (Frans van Galen and Catherine Twomey Fosnot, 2007, Context for Learning Mathematics).

ESSENTIAL QUESTIONS

- How can we use arrays to help develop an understanding of the commutative property?
- How does drawing an array help us think about different ways to decompose a number?

MATERIALS

- “Seating Arrangements” recording sheet
- Grid paper, if needed
- Manipulatives, if needed

GROUPING

Individual/Partner Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Part I (SMP 1, 4, 5, and 6)

You may want to provide grid paper or have students draw the arrays on plain copy paper. Students should develop the following arrays: 1×24 , 2×12 , 3×8 , 4×6 , 24×1 , 12×2 , 8×3 , and 6×4 . As students examine both the 4×6 array and the 6×4 array, for instance, help them understand that while both arrays have the same area, their orientation can make a difference. For example, when arranging chairs in a room, the shape of the room could dictate whether there are 6 rows of 4 chairs or 4 rows of 6 chairs. Use this to introduce the commutative property of multiplication.

Part II (SMP 1, 2, 3, 4, 6, and 7)

Students will follow the directions below from the “Seating Arrangements” recording sheet.

Your class is going to have a special presentation and your teacher has asked you to figure out a good way to place 24 chairs in your room for seating. There is only one requirement. All the chairs must be placed in an array.

1. Draw pictures to show all the ways you can arrange the chairs in an array.
2. Label and write matching number sentences for each array.
3. Choose your favorite arrangement and explain why you think it would be the best arrangement so that every student could see the presentation.

Once all students have completed the task, have a class discussion about strategies used to complete the task.

FORMATIVE ASSESSMENT QUESTIONS

- Explain how you built each array.
- With 24 blocks, can you have an array with 7 in each row? Why or why not?
- Is there a way to determine the measurements of an array for 24 without building it with blocks or drawing a diagram?
- How many different solutions do you think there are to this problem? Is there a way to check to see if you have found all possible solutions?

DIFFERENTIATION

Extension

- Using 24, or another appropriate number, have students multiply to find the number of chairs needed for 2, 3, 4, 5, and 6 third grade classrooms that use twenty-four chairs each. Ask students to develop a strategy to solve the problem. Then allow students to share their strategies.

Intervention

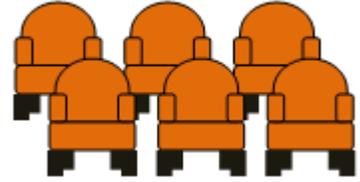
- Replace 24 with a smaller number such as 12, 18 or 20.
- Model this task or a similar one in a small group setting.

TECHNOLOGY CONNECTION

- <http://illuminations.nctm.org/LessonDetail.aspx?id=U109>
This site contains numerous ideas for introducing multiplication, including the array model.

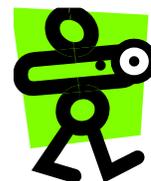
Name _____ Date _____

Seating Arrangement



Your class is going to have a special presentation and your teacher has asked you to figure out a good way to place 24 chairs in your room for seating. There is only one requirement. All the chairs must be placed in an array.

1. Draw pictures to show all the ways you can arrange the chairs in an array.
2. Label and write matching number sentences for each array.
3. Choose your favorite arrangement and explain why you think it would be the best arrangement so that every student can see the presentation.



SCAFFOLDING TASK: STUCK ON DIVISION

In this task, students will experiment with a set of 12 connecting cubes to determine the division patterns when the dividend is 12.

APPROXIMATE TIME – 1 Class Session

CONTENT STANDARDS

MGSE3.OA.2 Interpret whole number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares (How many in each group?), or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each (How many groups can you make?). For example, describe a context in which a number of shares or a number of groups can be expressed as $56 \div 8$.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

Students should clearly understand how to write number sentences and how to follow written directions before working independently.

One possible solution is shown on the following page:

Division is...	Diagram	Number Sentence
Repeated subtraction "I took two circles away each time. I subtracted 2, 6 times."		$12 - 2 - 2 - 2 - 2 - 2 - 2 = 0$
Separating a whole into equal groups "I separated the circles into groups of 4. I have 3 groups of four."		$12 \div 4 = 3$
The opposite of multiplication "I have an array with four rows of three. That can be written as $4 \times 3 = 12$ or $12 \div 3 = 4$."		$4 \times 3 = 12$ $3 \times 4 = 12$ $12 \div 4 = 3$ $12 \div 3 = 4$

COMMON MISCONCEPTIONS

The three ways of looking at division (separating into equal groups, repeated subtraction, and inverse of multiplication) are closely related and may be difficult for students to verbalize initially as they make connections between concrete models and their corresponding number sentences. Therefore, students need multiple experiences using a given number of cubes to model repeated subtraction, form equal groups, and explain how these two activities are alike and different. They also need to understand the inverse relationship of multiplication and division. Help students make connections to the language of mathematics and between visual and symbolic representations.

ESSENTIAL QUESTIONS

- How can we model division?
- How are multiplication and division related?
- How are subtraction and division related?
- How can we write a mathematical sentence to represent division models we have made?

MATERIALS

- 12 connecting cubes **per student**
- “Stuck on Division” task sheet
- “Stuck on Division” recording sheet
- *Divide and Ride* by Stuart J. Murphy or similar book

GROUPING

Individual/Partner Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will experiment with a set of 12 connecting cubes to determine the division patterns when the dividend is 12.

Part I

You may choose to open this task by reading, discussing, and modeling the events in *Divide and Ride* by Stuart J. Murphy. *Divide and Ride* is a story about dividing a group of children to ride amusement park rides. Another suitable book about division is *One Hundred Hungry Ants* by Elinor J. Pinczes. Focus on the different ways division can be described (separating into equal groups, repeated subtraction, and inverse of multiplication.)

Part II (SMP 1, 2, 3, 4, 5, 6, and 7)

Students will follow the directions below from the “Stuck on Division” task sheet.

Use 12 connecting cubes to complete this task.

1. Begin with 12 cubes and remove the same number of cubes over and over again until there are none left. Remember, you must remove the *same number* each time. Make a model of your idea with the cubes.
2. Use the first row of the “Stuck on Division” recording sheet to
 - a. write about what you did
 - b. draw a diagram of your model
 - c. write a subtraction number sentence that describes your model
3. Find a way to separate your cubes into equal groups. How can you show the dividend, divisor, and quotient with your cubes?

4. Use the second row of the “Stuck on Division” recording sheet to
 - a. write about what you did
 - b. draw a diagram of your cube groups
 - c. write a division number sentence
5. Now think of a multiplication fact whose product is twelve. Can you make groups of cubes that prove that division is the opposite of multiplication?
6. Use the third row of the “Stuck on Division” recording sheet to
 - a. write about what you did
 - b. draw a diagram of your cube groups
 - c. write the fact family for your diagram
7. Compare your answers with your friends. Did everyone have the same answers? How can you tell whose solutions are correct? What different strategies did you use?

FORMATIVE ASSESSMENT QUESTIONS

- Can you explain more than one way to think about dividing a number?
- How can you write your model in a number sentence so others will understand your model?
- How can we show your model as both a division number sentence and a subtraction number sentence?

DIFFERENTIATION

Extension

Have students to complete the chart with 13 blocks. Ask students to include leftovers in their explanations, diagrams, and number sentences.

Intervention

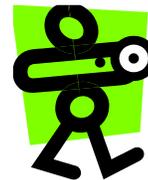
Direct instruction in small groups can provide support for students who struggle with these concepts and can enable them to develop the ability to describe their thinking.

TECHNOLOGY CONNECTION

- <http://mcq.wrdsb.on.ca/Admin/Documents/WORC/PDFs/LESSON%20PrimaryMath.pdf>
- <http://www.lessonplanspage.com/MathLAMultiplicationDivisionUsingTheDoorbellRang23.htm>
Both websites provide teacher resources for *The Doorbell Rang* by Pat Hutchins.
- http://www.stuartjmurphy.com/activities/activity_ideas.php Stuart Murphy website with activity suggestions for *Divide and Ride*. (level 3 and then click book title).

Name _____ Date _____

Stuck on Division
Task Sheet

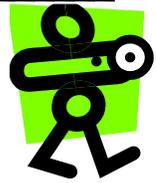


Use 12 connecting cubes to complete this task.

1. Begin with 12 cubes and remove the same number of cubes over and over again until there are none left. Remember, you must remove the *same number* each time. Make a model of your idea with the cubes.
2. Use the first row of the "Stuck on Division" recording sheet to
 - a. write about what you did
 - b. draw a diagram of your model
 - c. write a subtraction number sentence that describes your model
3. Find a way to separate your cubes into equal groups. How can you show the dividend, divisor, and quotient with your cubes?
4. Use the second row of the "Stuck on Division" recording sheet to
 - a. write about what you did
 - b. draw a diagram of your cube groups
 - c. write a division number sentence
5. Now think of a multiplication fact whose product is twelve. Can you make groups of cubes that prove that division is the opposite of multiplication?
6. Use the third row of the "Stuck on Division" recording sheet to
 - a. write about what you did
 - b. draw a diagram of your cube groups
 - c. write the fact family for your diagram
7. Compare your answers with your friends. Did everyone have the same answers? How can you tell whose solutions are correct?

Name _____ Date _____

Stuck on Division
Recording Sheet



Division is...	Diagram	Number Sentence
Repeated subtraction		
Separating a whole into equal groups		
The opposite of multiplication		



3 ACT TASK: APPLE SOLAR FARM

Task Adapted from: <http://www.101qs.com/2836>

APPROXIMATE TIME: 1 class period

CONTENT STANDARDS

MGSE3.NBT.3 Multiply one-digit whole numbers by multiples of 10 in the range 10-90 (e.g., 9×80 , 5×60) using strategies based on place value and properties of operations.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make sense of structure.

ESSENTIAL QUESTIONS

In order to maintain a student-inquiry-based approach to this task, it may be beneficial to wait until Act 2 to share the EQ's with your students. By doing this, students will be allowed the opportunity to be very creative with their thinking in Act 1. By sharing the EQ's in Act 2, you will be able to narrow the focus of inquiry so that the outcome results in student learning directly related to the content standards aligned with this task.

- How can multiplication be represented?
- How does an array represent the meaning of multiplication?
- What strategies can help you solve real world multiplication problems?



MATERIALS

- Act 1 picture (attached)
- Student recording sheet

GROUPING

Individual/Partner and or Small Group

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will view the picture provided and tell what they noticed. Next, they will be asked to discuss what they wonder about or are curious about. These questions will be recorded on a class chart or on the board and on the student recording sheet. Students will then use mathematics to answer their own questions. Students will be given information to solve the problem based on **need**. When they realize they don't have the information they need, and ask for it, it will be given to them.

BACKGROUND KNOWLEDGE AND COMMON MISCONCEPTIONS:

This task follows the 3-Act Math Task format originally developed by Dan Meyer. More information on this type of task may be found at <http://blog.mrmeyer.com/category/3acts/>. A Three-Act Task is a whole-group mathematics task consisting of 3 distinct parts: an engaging and perplexing Act One, an information and solution seeking Act Two, and a solution discussion and solution revealing Act Three. More information along with guidelines for 3-Act Tasks may be found in the *Guide to Three-Act Tasks* on georgiastandards.org and the K-5 GSE Mathematics Wiki.

This task allows students to work on multiplication by having them apply their understanding of place value. In this task, students will go beyond tricks that hinder understanding such as “just adding zeros” and explain and reason about their products. For example, for the problem 50×4 , students should think of this as 4 groups of 5 tens or 20 tens.

It is important to address any misconceptions that students may have with “just adding zeros”. Students need to be able to think in terms of ___ groups of ____ tens.

TASK DIRECTIONS:

Act 1 – Whole Group - Pose the conflict and introduce students to the scenario by showing Act I picture. (Dan Meyer <http://blog.mrmeyer.com/2011/the-three-acts-of-a-mathematical-story/>)
“Introduce the central conflict of your story/task clearly, visually, viscerally, using as few words as possible.”

- Show Act 1 picture to students (Depending on students' prior knowledge, it may be beneficial to describe to students what a solar panel is.)



- Ask students what they noticed in the picture, what they wonder about, and what questions they have about what they saw in the picture. Do a think-pair-share so that students have an opportunity to talk with each other before sharing questions with the whole group.
- Share and record students' questions. The teacher may need to guide students so that the questions generated are math-related.

Anticipated questions students may ask and wish to answer: (*Main question(s) to be investigated)

- How many solar panels are in a row?
- Does every section have the same number of panels?
- *How many solar panels are pictured?
- Once students have their question, ask the students to estimate answers to their questions (think-pair-share). Students will write their best estimate, then write two more estimates – one that is too low and one that is too high so that they establish a range in which the solution should occur. Students should plot their three estimates on an empty number line. Note: As the facilitator, you may choose to allow the students to answer their own posed questions, one question that a fellow student posed, or a related question listed above. For students to be completely engaged in the inquiry-based problem solving process, it is important for them to experience ownership of the questions posed.

Important note: Although students will only investigate the main question(s) for this task, it is important for the teacher to not ignore student generated questions. Additional questions may be answered after they've found a solution to the main question, or as homework or extra projects.

Act 2 – Student Exploration - Provide additional information as students work toward solutions to their questions. (Dan Meyer <http://blog.mrmeyer.com/2011/the-three-acts-of-a-mathematical-story/>)
“The protagonist/student overcomes obstacles, looks for resources, and develops new tools.”

- During Act 2, students decide on the facts, tools, and other information needed to answer the question(s) (from Act 1). When students decide what they need to solve the problem, they should ask for those things. It is pivotal to the problem solving process that students decide what is needed without being given the information up front.

- Required Information:
 - 30 panels in each row
 - 10 rows in each section

- Some groups might need scaffolds to guide them. The teacher should question groups who seem to be moving in the wrong direction or might not know where to begin. Questioning is an effective strategy that can be used, with questions such as:
 - What is the problem you are trying to solve?
 - What do you think affects the situation?
 - Can you explain what you've done so far?
 - What strategies are you using?
 - What assumptions are you making?
 - What tools or models may help you?
 - Why is that true?
 - Does that make sense?

Act 3 – Whole Group – Share solutions and strategies.

- Students to present their solutions and strategies and compare them.
- Reveal the solution:
 - 300 panels in each section.
 - About 7 complete sections pictured
 - About 2500 panels are pictured.

- Lead discussion to compare these, asking questions such as:
 - How reasonable was your estimate?
 - Which strategy was most efficient?
 - Can you think of another method that might have worked?
 - What might you do differently next time?

Act 4, The Sequel - “The goals of the sequel task are to a) challenge students who finished quickly so b) I can help students who need my help. It can't feel like punishment for good work. It can't seem like drudgery. It has to entice and activate the imagination.” Dan Meyer
<http://blog.mrmeyer.com/2013/teaching-with-three-act-tasks-act-three-sequel/>

For Act 4, reference other student-generated questions that could be used for additional classwork, projects or homework.

FORMATIVE ASSESSMENT QUESTIONS

- What models did you create?
- What organizational strategies did you use?

DIFFERENTIATION

Extension

- Find additional pictures of solar panel farms, and allow students to estimate total number of panels followed by finding the total number of panels in the farm.
- Provide students with information such as, “If each row had an additional 5 (choose any number you feel fitting), how would the total number of panels be affected?”

Intervention

- Provide base-ten manipulatives for the students to create the sections of the panels.

Georgia Department of Education
Georgia Standards of Excellence Framework
GSE The Relationship Between Multiplication and Division • Unit #2

Act 1 Picture:



Task Title: _____

Name: _____

Adapted from Andrew Stadel

ACT 1

What did/do you notice?

What questions come to your mind?

Main Question: _____

What is your 1st estimate and why?

On an empty number line, record an estimate that is too low and an estimate that is too high.

ACT 2

What information would you like to know or need to solve the MAIN question?

Record the given information (measurements, materials, etc...)

If possible, give a better estimation with this information: _____

Act 2 (con't)

Use this area for your work, tables, calculations, sketches, and final solution.

ACT 3

What was the result?



PRACTICE TASK: BASE TEN MULTIPLICATION

(Inspired by Catherine Twomey Fosnot's, *Young Mathematicians at Work, Constructing Multiplication and Division*)

In this task students determine the factors of 100 by creating addition and/or multiplication models by placing equal number of Base Ten Blocks of a kind on index cards according to the spin of a spinner. Students then record the number sentences that their model represents.

CONTENT STANDARDS

MGSE3.OA.1. Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5×7 .*

STANDARDS FOR MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

This standard interprets products of whole numbers. Students recognize multiplication as a means to determine the total number of objects when there are a specific number of groups with the same number of objects in each group. Multiplication requires students to think in terms of groups of things rather than individual things. Students learn that the multiplication symbol 'x' means "groups of" and problems such as 5×7 refer to 5 groups of 7.

Example: Jim purchased 5 packages of muffins. Each package contained 3 muffins. How many muffins did Jim purchase? (5 groups of 3, $5 \times 3 = 15$)

Describe another situation where there would be 5 groups of 3 or 5×3 .

COMMON MISCONCEPTIONS

When students begin multiplication they are just getting used to counting. Before multiplication, 6 equaled a group of six objects. They also know that 4 equals a group of four objects. However, to think of 4×6 they have to think of the group of six as one unit because they need to make four sixes. The four is now used to count groups not objects. This is a hard concept to grasp for

students just learning about numbers. Students have to reorganize their thinking (Frans van Galen and Catherine Twomey Fosnot, 2007, *Contexts for Learning Mathematics*). The following task will give students practice in reorganizing numbers and developing strategies that allow them to make sense of the mathematics.

ESSENTIAL QUESTIONS

- What are the strategies for learning multiplication?
- How can we practice multiplication facts in a meaningful way that will help us remember them?
- How is the commutative property of multiplication evident in an array model?

MATERIALS

- Base Ten Blocks, up to 51 cubes and 60 longs per pair (base 10 template has been provided as well)
- Spinner, numbered 1-9
- Packs of 3" X 5" index cards, from 1 to 9 cards per pack, 1 pack per pair
- Overhead Base Ten Blocks (optional)
- Math journal

GROUPING

Partners

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See *Minilessons for Early Multiplication and Division* by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Part I: (SMP 1, 2, and 6)

Ask two volunteers to hold out their hands, palms up.

Place 2 units into each hand. Ask students how they can find the number of units in the four hands. Lead students to counting the units by twos. Record this process as the addition sentence $2 + 2 + 2 + 2 = 8$. Elicit that 2 units in each of 4 hands means that there is a total of 8 units. Point out that because the same number, 2, is added 4 times, another way of recording this is with multiplication. Write the multiplication sentence $4 \times 2 = 8$ on the board. Read it aloud as “Four groups of two equal eight.” Have students to suggest ways to record 2 cubes in each of 4 hands.

Mathematics • GSE Third Grade • Unit 2: The Relationship Between Multiplication and Division

Richard Woods, State School Superintendent

July 2015 • Page 80 of 180

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Part II: (SMP 1, 2, 4, 6, and 7)

Before the task, decide which facts students need the most work with. This will be the number of cards the students will need, this can vary from group to group. Distribute the prearranged packs of index cards to the students. Instruct the students to determine how many cards are in their packs. They will spread out the cards, (the cards are the groups), then spin a spinner. The number that was spun will determine the number of unit blocks on each card. (the number of units in each group).

- *How many cards?*
- *How many units on each?*

The students will determine the product and record the number sentence in their math journal.

Part III (SMP 1, 2, 4, 6, and 7)

Next students will clear off their cards and put an equal number of longs in their place.

- *How many cards?*
- *How many longs on each?*

Students will determine the product of the longs and record their number sentence in the math journal. Students will be asked to compare the values they found for the units and for the same number of longs. What did they notice? Repeat the activity several times. (If you spin the same number as before, spin again!)

FORMATIVE ASSESSMENT QUESTIONS

- What patterns are you noticing?
- What is the relationship between the units and the longs?
- How did you determine your product?
- Could you have determined your product another way?

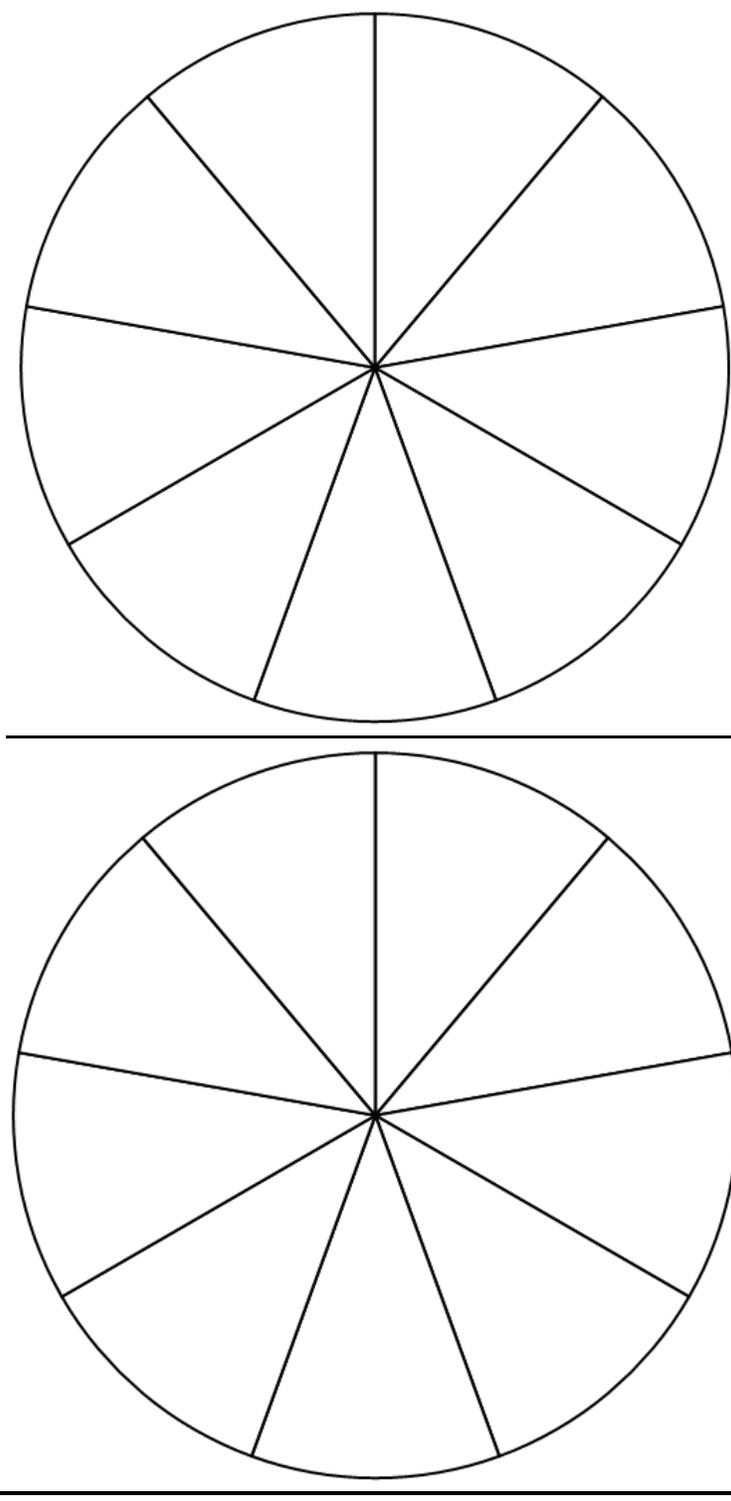
DIFFERENTIATION

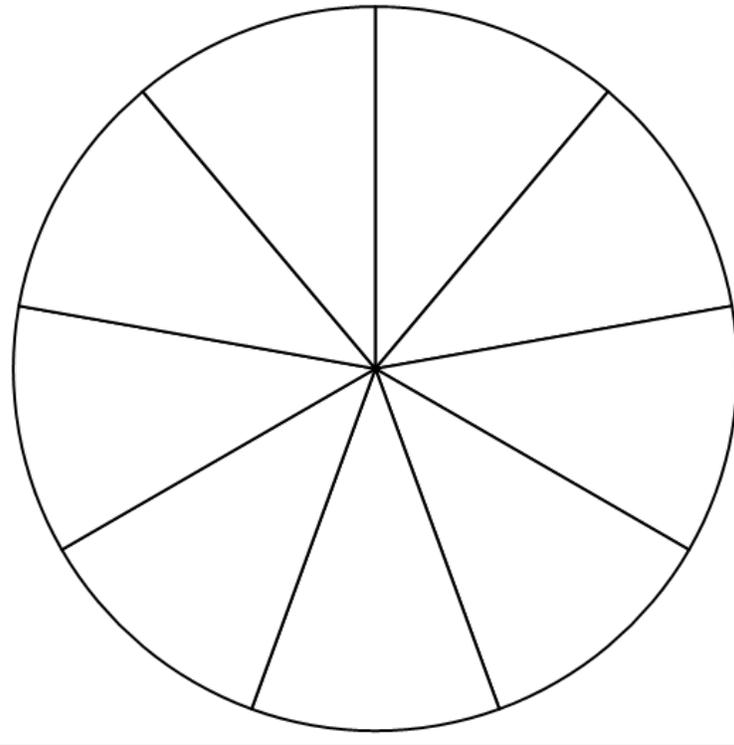
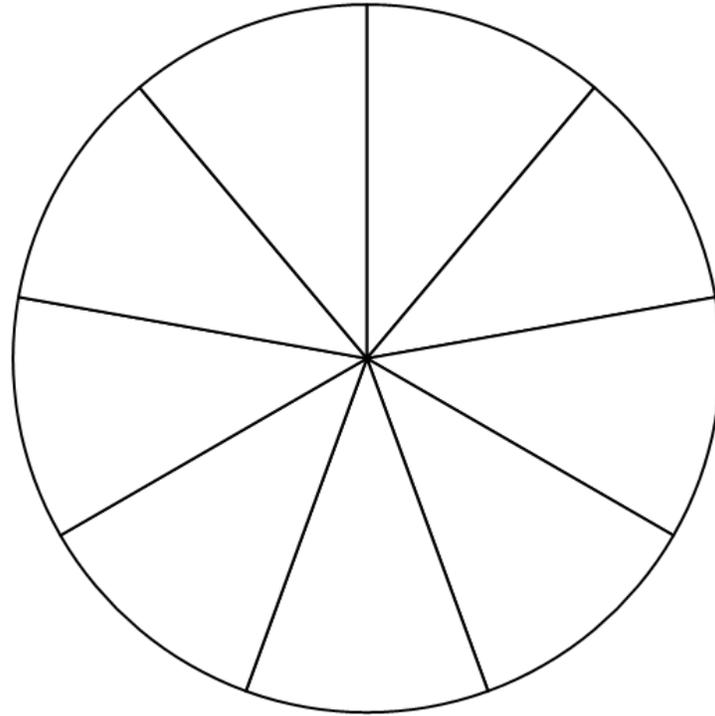
Extension

- Instead of using manipulatives to create groups, use digit cards.

Intervention

- Use smaller numbers on the spinner.





CONSTRUCTING TASK: “MULTIPLES OF TEN”

Adapted from ETA Cuisenaire



This task allows students to apply their understanding of place value to multiplication of tens.

CONTENT STANDARDS

MGSE3.NBT.3 Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9×80 , 5×60) using strategies based on place value and properties of operations.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

(adapted from North Carolina’s DPI resources)

This task allows students to work in multiplication by having them apply their understanding of place value. In this task, students will go beyond tricks that hinder understanding such as “just adding zeros” and explain and reason about their products. For example, for the problem 50×4 , students should think of this as 4 groups of 5 tens or 20 tens.

COMMON MISCONCEPTIONS

It is important to address any misconceptions that students may have with “just adding zeros”. Students need to be able to think in terms of ___ groups of ____ tens.

Additionally, student misconceptions with this task may be with their lack of understanding of place value. When working with longs, students may see the group as a group of 1 instead of a group of 10. For example, when counting 5 longs the student may count them as “1, 2, 3, 4, 5” with a total of 5 objects instead of counting them as “10, 20, 30, 40, 50” or “5 groups of 10” with a total of 50. It is important for students to have this understanding of the long consisting of 10 units.

ESSENTIAL QUESTIONS

- What happens to a number when it is multiplied by ten?
- How can I model multiplication by ten?
- How is place value related to multiples of ten?

MATERIALS

- Base Ten Blocks
- Multiples of Ten Slips one set 10-100, and one set over 100 (teacher created- these are cards/slips with decade numbers on them)
- Paper bag or container (to hold multiples of ten slips)
- Large Index Cards (10) each with a decade 10-90 on it (teacher created)
- Blank index cards.

GROUPING

Students should work with a partner, or small group.

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See *Minilessons for Early Multiplication and Division* by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Students will build snap cube structures using multiples of 10 and order the structures according to the number of cubes from which they were built. In this learning task, students should have the opportunity to:

- Count out large and small quantities of objects
- Work with multiples of 10
- Develop number sense about the relative magnitude of a number
- Work with conservation of number

Part I (SMP 1, 2, 3, and 6)

To begin, present 10 large cards displaying the decade numbers (10, 20, 30, 40, etc.) Place the 50 in the middle of a chalkboard tray, or in the middle of the floor if you are in a circle on the rug. Hand a large card to a student and ask where it belongs on the chalkboard tray. Have them explain their reasoning. Repeat this process again. When the students have decided where to place the second card and have explained their reasoning, ask them to decide which numbers are

missing and where they might go. Allow students to complete the number line. Discuss how many tens are in each number as they are placed on the number line, and the magnitude of each number.

Part II (SMP 1, 2, 4, 5, 6, and 7)

Each pair of students will:

- Draw a Multiple of Ten slip from a bag. It should be a decade number 10-90
- Provide students with Base Ten blocks. Ask them to make an array that will match their number. Ideally, one of the students will realize that they can use the 10 rods to make the arrays instead of the unit cubes.
- Have students create a T-Chart that looks similar to the one below. Students should record the number drawn and write an addition sentence to match their array. (Students have not been formally introduced to multiplication yet)

Number Chosen	Addition Sentence
40	$10+10+10+10$
30	$10+10+10$
50	$10+10+10+10+10$

- Students may pull several numbers to have a good comparison of their arrays.
- Once students have had many opportunities to draw from the bag and create arrays, bring them back to the carpet for a discussion.
 - How did you form your arrays?
 - Which blocks did you use?
 - Look at your number sentences. What do you notice about them?
 - How are the number chosen and the number sentence related?
- At this point you will ask students if they know how to write a multiplication number sentence that matches the addition number sentence.

Part III (SMP 1, 2, 3, 4, 5, 6, 7)

Once students complete their arrays, and have recognized the relationship between multiplying and addition, lead a discussion about the arrays using the following:

- Knowing what you know about tens, can you make an array for the number 120? Explain your thinking.
- Have each group choose one additional number from Multiples of Ten (numbers over 100).
- They will add on to the previous T-Chart with the new number. Encourage them to make an addition sentence, then a multiplication sentence.
- Discuss the patterns that they notice.

FORMATIVE ASSESSMENT QUESTIONS:

- How are you forming your arrays?
- How can you write a number sentence to match your array?
- What do you notice about the number pulled and your addition sentence?
- What happens to a number when it is multiplied by ten?

DIFFERENTIATION

Extension

- Students should investigate multiplying various decade numbers by digits 1-9 (40×6) by building arrays using a variety of manipulatives (tiles, connecting cubes, base ten materials, and graph paper are some suggestions).

Intervention

- These students should begin with decade numbers that match multiplication fact strategies that the student is comfortably using. For example, a student may know the $\times 2$ facts because he/she relates them to doubles facts for addition. The teacher structures problems for this student around $\times 20$, gradually allowing the student to make sense of the relationship between what he/she already knows ($\times 2$) and the new strategy ($\times 20$).



PERFORMANCE TASK: “HOW MANY TENS?”

Adapted from NZ Maths

This task further relates multiples of ten to place value by giving students the opportunity to build onto the concept that 10 tens equal one hundred, and 10 hundreds equal one thousand.

CONTENT STANDARDS

MGSE3.NBT.3 Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9×80 , 5×60) using strategies based on place value and properties of operations.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

This task is designed to develop the concept of what happens to a number when multiplied by a multiple of ten. To help build context, the teacher may read *100 Hungry Ants* by J. Pinzces. Students need to know that 10 tens make 100 and 10 hundreds make one thousand.

COMMON MISCONCEPTION

It is important to address any misconceptions that students may have with “just adding zeros”. Students need to be able to think in terms of ___ groups of ____ tens.

Additionally, student misconceptions with this task may be with their understanding of place value. When working with longs, students may see the group as a group of 1 instead of a group of 10. For example, when counting 5 longs the student may count them as “1, 2, 3, 4, 5” with a total of 5 objects instead of counting them as “10, 20, 30, 40, 50” or “5 groups of 10” with a total of 50. It is important for students to have this understanding of the long consisting of 10 units.

ESSENTIAL QUESTIONS

- How can I model multiplication by ten?
- How is multiplying by ten related to place value?

MATERIALS

- Money Manipulatives
- “How many 10s” recording sheet

GROUPING

Students should work in groups of 3 to 4 members.

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Part I (SMP 1, 3, and 6)

Read the book, *100 Hungry Ants* by J. Pinzces to your students. During strategic points throughout the book, stop to discuss how the number 100 can be built or created from different groups of ten. (This is a perfect “anchor chart” opportunity!) Facilitate a classroom discussion about tens and hundreds to assess prior knowledge, and use this as a platform for a brief mini-lesson (if needed). Have the students work with their small groups to investigate, model (very important), and figure out the following problems:

1. What are all of the possible ways the ants could have lined up (by multiples of 10) to reach the picnic?
2. What would have been the QUICKEST way for the ants to march to the picnic so they could have gotten there before all of the food was gone?

Part II (SMP 1, 2, 6, 7, and 8)

Read the scenario to the students.

Problem: The Bank of Mathematics has run out of \$100 bills. Alison wants to withdraw \$300 in \$10 dollar bills. How many \$10 dollar bills does she get? Can you figure out how many \$10 bills she will need with different amounts such as \$600 or \$900?

Students will record answers in the “How Many Tens” table.

Repeat the same concept using the scenario below and \$10 and \$1 bills.

Problem: The Bank of Mathematics has run out of \$100 bills. Alison wants to withdraw \$256 in \$10 and \$1 bills. How many of each bill will she receive?

Students will record answers in “How Many Tens” table.

FORMATIVE ASSESSMENT QUESTIONS

- How did you determine how many tens to give?
- What if you didn’t have any tens, what could you use?
- How does Multiplication help you determine the amount of tens needed to withdraw?

DIFFERENTIATION

Extension

- Students can determine the number of ones, then tens, then hundreds it would take to reach various student-suggested amounts. Organize the information into a student-created table, look for patterns, and explain what you see.

Intervention (SMP 4 and 5)

- Students can complete this activity with smaller amounts of money.
- Students can complete only the first part of the recording sheet.
- Students can complete the second part of the recording sheet with amounts rounded to the nearest hundred.
- Students should be given Base Ten blocks or money to help them make sense of the problem.



Recording Sheet: How Many Tens?

1. The Bank of Mathematics has run out of \$100 bills. Alison wants to withdraw \$300 in \$10 dollar bills. How many \$10 dollar bills does she get? Can you figure out how many \$10 bills she will need with different amounts such as \$600 or \$900?

How Many Tens?

Withdraw	How many \$10.00 bills?
\$300.00	
\$600.00	
\$900.00	
\$700.00	
\$500.00	
\$200.00	
\$800.00	

Reflection:

How did you determine the amount of \$10.00 bills needed?

2. The Bank of Mathematics has run out of \$100 bills. Alison wants to withdraw \$256 in \$10 bills. How many of each bill will she receive?

How Many Tens and Ones?

Withdraw	\$10.00	\$1.00
\$256.00		
\$352.00		
\$468.00		
\$853.00		
\$523.00		
\$631.00		
\$750.00		

Reflection:

How did you determine the amount of \$1.00 and \$10.00 bills needed?

Extension Problem:

Tickets to a concert cost \$100 each. How many tickets could you buy if you have \$3215?



CONSTRUCTING TASK: WHAT COMES FIRST, THE CHICKEN OR THE EGG? (adapted from *Teaching Children Mathematics*, Volume 15, Number 3, October 2008, p. 160)

In this task, students will use estimation skills to multiply by groups of ten.

CONTENT STANDARDS

MGSE3.OA.4 Determine the unknown whole number in a multiplication or division equation relating three whole numbers using the inverse relationship of multiplication and division. For example, determine the unknown number that makes the equation true in each of the equations, $8 \times ? = 48$, $5 = \square \div 3$, $6 \times 6 = ?$.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

This task provides students with an opportunity to develop and discuss strategies for multiplying and/or dividing larger numbers. Various operations can be used to solve this problem. Possible strategies students may use to solve this type of problem include, using base 10 blocks, using their knowledge of multiplication and inverse operations, repeated addition, or using repeated subtraction. Third grade is students' first exposure to larger number division/multiplication and it is important to allow students time to make sense of this operation, so that they will continue to be successful with division in later grades.

If students choose to do division within this task, the conversation of remainders will naturally arise. Although remainders are not mentioned in the standards, students will encounter them naturally when dividing and they should be addressed as they come up. These conversations will lead nicely into the fourth grade standard OA3 when the remainder must be interpreted.

COMMON MISCONCEPTIONS

Students may have difficulty seeing multiplication and division as inverse operations. In order to develop an understanding of this relationship, students need to have ample opportunities to explore these two operations simultaneously.

ESSENTIAL QUESTIONS

- How can multiplication and division be used to solve real world problems?
- How can we use patterns to solve problems?

MATERIALS

- “What Comes First?” recording sheet
- drawing paper
- interlocking cubes or other manipulative if necessary

GROUPING

Individual/Partner Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Part I

Begin this task by reviewing their understanding of estimation from Unit 1. Discuss the word “approximate” and how it is used in estimating. Students should understand that rounding is not the only form of estimation.

Part II (SMP 1, 2, 3 6, and 7)

Students will follow the directions on the “What Comes First” recording sheet. This should be solved using pictures, numbers, and words.

If most hens lay about 4 eggs each week, how many eggs does the average hen lay in one month? How many chickens would be needed to produce 50 eggs in one month? How many chickens would be needed to produce 70 eggs in one month? If 30 eggs were produced in one month, approximately how many chickens were needed to produce them?

Once all students have completed the task, hold a class discussion in which all students/groups will share the strategies used in solving the problem.

FORMATIVE ASSESSMENT QUESTIONS

- How could you use patterns to help you solve this?

- How would a table be useful in solving this problem?
- How might you use multiplication/division to solve this problem?
- Could you write a number sentence to explain your picture/table?
- How can you use estimation to help you solve this problem?

DIFFERENTIATION

Extension

- Students could determine how many eggs a hen will lay in one year. (2 hens, 3 hens, etc.)

Intervention

- Decrease the number of eggs needed each month to numbers that 4 will divide into evenly such as (24, 36, 48)
- Provide manipulatives for students to use while solving the task.



CONSTRUCTING TASK: SHARING PUMPKIN SEEDS

In this task, students will decide how to share pumpkin seeds fairly with a group of children.

CONTENT STANDARDS

MGSE3.OA.2 Interpret whole number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares (How many in each group?), or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each (How many groups can you make?). For example, describe a context in which a number of shares or a number of groups can be expressed as $56 \div 8$.

MGSE3.OA.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities,[‡] e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.¹⁰ ‡See Glossary: Multiplication and Division Within 100.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

This task provides students with an opportunity to develop and discuss strategies for dividing a two- or three-digit number by a one-digit number. Possible strategies students may use to solve this type of problem include, using base 10 blocks, using their knowledge of multiplication and inverse operations, or using repeated subtraction. Third grade is students' first exposure to larger number division and it is important to allow students time to make sense of this operation, so that students will continue to be successful with division in later grades.

This task can be paired with the following science standard: S3L1b. Identify features of green plants that allow them to live and thrive in different regions of Georgia. There are many children's books about pumpkins and pumpkin seeds, any one of them could be used as an introduction to this task. One book that deals directly with the number of seeds in a pumpkin is *How Many Seeds in a Pumpkin?* by Margaret McNamara, Illustrated by G. Brian Karas.

¹⁰ See glossary, Table 2

COMMON MISCONCEPTIONS

Students may have difficulty seeing multiplication and division as inverse operations. In order to develop an understanding of this relationship, students need to have ample opportunities to explore these two operations simultaneously.

ESSENTIAL QUESTIONS

- How can we divide larger numbers?
- What strategy did you find most efficient when dividing?

MATERIALS

- “Sharing Pumpkin Seeds” recording sheet
- Base 10 blocks or other materials for counting available for students who wish to use them
- *How Many Seeds in a Pumpkin?* by Margaret McNamara or similar book

GROUPING

Individual/Partner Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See *Minilessons for Early Multiplication and Division* by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2, 3, 4, 6, and 7)

Students will solve the two sharing problems on the “Sharing Pumpkin Seeds” recording sheet.

Problem 1

Ben and his 3 friends toasted 80 pumpkin seeds from their pumpkin. How many seeds will each child get if they share the pumpkin seeds fairly? Clearly explain your thinking using words, numbers, and/or pictures.

Students may approach the problem $80 \div 4$ in a variety of ways. Some students may build on their understanding of multiplication as the inverse of division to solve the problem.

Example 1

I know $4 \times 2 = 8$, so $4 \times 20 = 80$. If I add 4 groups of 20, I know there are a total of 80. Therefore, each child will get 20 pumpkin seeds.

Other students may build on their understanding of division as repeated subtraction.

Example 2

$4 \times 10 = 40$ $80 - 40 = 40$
Each child got 10 pumpkin seeds.

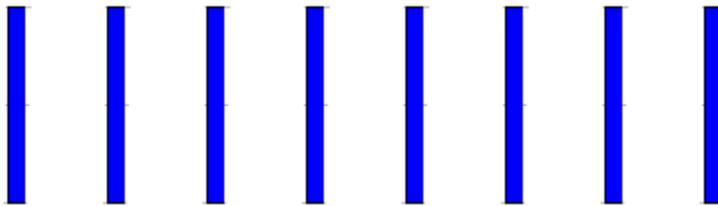
$4 \times 10 = 40$ $40 - 40 = 0$
Each child got 10 more pumpkin seeds.

Each child received a total of $10 + 10$ pumpkin seeds or 20 pumpkin seeds.

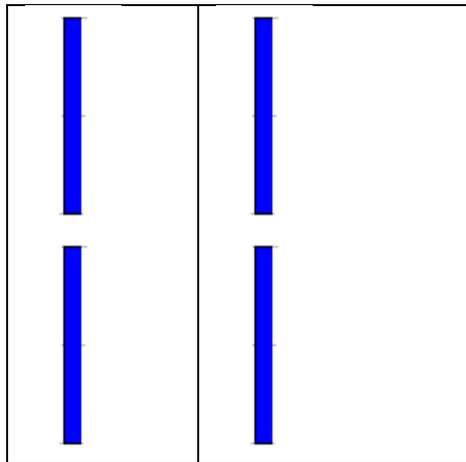
Some students may choose to use base 10 blocks to represent the division problem.

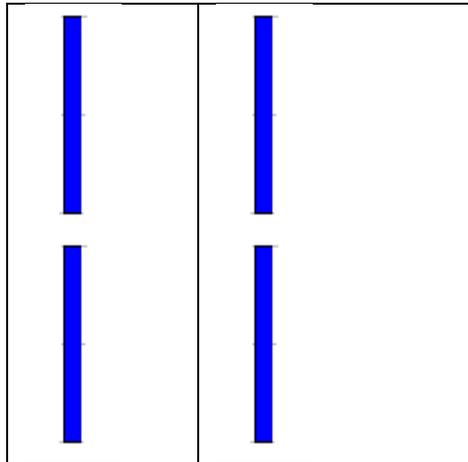
Example 3

First I took out blocks equal to 80.



Then I started sharing the ten strips among four groups.





Have students compare strategies used to solve each problem. Encourage them to look for similarities and differences in their approaches to the problem and to discuss the efficiency of each. Ask students to present their findings to the class.

FORMATIVE ASSESSMENT QUESTIONS

- What is your plan to solve this problem?
- How do you know your answer is correct?
- How does this help you answer the question in the problem?

DIFFERENTIATION

Extension

- Students can add their own division word problems within the context of sharing pumpkin seeds. These problems can be completed by a partner.

Intervention

- Give students manipulatives to assist in solving the problems.

TECHNOLOGY CONNECTION

- <http://mason.gmu.edu/~mmankus/whole/base10/asmdb10.htm#div>
This site for teachers and parents provides information on using base 10 blocks to solve division problems with an area model.

Name _____

Date _____

Sharing Pumpkin Seeds

Ben and his 3 friends toasted 80 pumpkin seeds from their pumpkin. How many seeds will each child get if they share the pumpkin seeds fairly? Clearly explain your thinking using words, numbers, and/or pictures.



Sarah and her 5 friends toasted 96 pumpkin seeds from their pumpkin. How many seeds will each child get if they share the pumpkin seeds fairly? Clearly explain your thinking using words, numbers, and/or pictures.

3 ACT TASK: EGG TOWER

APPROXIMATE TIME: 1 class period

CONTENT STANDARDS

MGSE3.OA.1 Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each. For example, describe a context in which a total number of objects can be expressed as 5×7 .



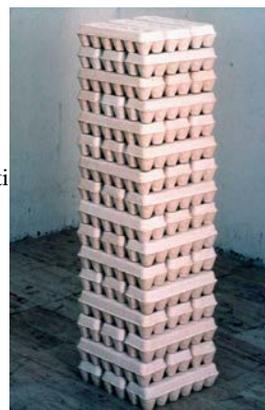
STANDARDS FOR MATHEMATICAL PRACTICE

- 1. Make sense of problems and persevere in solving them.** Students must make sense of the problem by identifying what information they need to solve it.
- 2. Reason abstractly and quantitatively.** Students were asked to make an estimate (high and low).
- 3. Construct viable arguments and critique the reasoning of others.** After writing down their own questions, students discuss their question with partners, creating the opportunity to construct the argument of why they chose their question, as well as critiquing the questions that others came up with.
- 4. Model with mathematics.** Once given the information, the students use that information to develop a mathematical model to solve their question.
- 5. Use appropriate tools strategically.** Students write their best estimate and two more estimates – one that is too low and one that is too high to establish a range in which the solution would occur.
- 6. Attend to precision.** Students use clear and precise language when discussing their strategies and sharing their own reasoning with others.
- 7. Look for and make sense of structure.** Students use their understanding of properties of operations as strategies to help develop an understanding of multiplicative structure.

ESSENTIAL QUESTIONS

In order to maintain a student-inquiry-based approach to this task, it may be beneficial to wait until Act 2 to share the EQ's with your students. By doing this, students will be allowed the opportunity to be very creative with their thinking in Act 1. By sharing the EQ's in Act 2, you will be able to narrow the focus of inquiry so that the outcome results in student learning directly related to the content standards aligned with this task.

- What strategies can help you solve real world multiplication problems?
- When can you use multiplication in real life?



MATERIALS

- Act 1 picture (attached)
- Student recording sheet

GROUPING

Individual/Partner and or Small Group

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will view the picture provided and tell what they noticed. Next, they will be asked to discuss what they wonder about or are curious about. These questions will be recorded on a class chart or on the board and on the student recording sheet. Students will then use mathematics to answer their own questions. Students will be given information to solve the problem based on **need**. When they realize they don't have the information they need, and ask for it, it will be given to them.

BACKGROUND KNOWLEDGE AND COMMON MISCONCEPTIONS:

This task follows the 3-Act Math Task format originally developed by Dan Meyer. More information on this type of task may be found at <http://blog.mrmeyer.com/category/3acts/>. A Three-Act Task is a whole-group mathematics task consisting of 3 distinct parts: an engaging and perplexing Act One, an information and solution seeking Act Two, and a solution discussion and solution revealing Act Three. More information along with guidelines for 3-Act Tasks may be found in the *Guide to Three-Act Tasks* on georgiastandards.org and the K-5 GSE Mathematics Wiki.

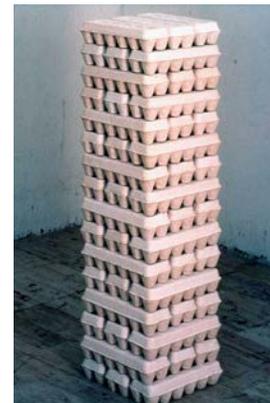
This standard interprets products of whole numbers. Students recognize multiplication as a means to determine the total number of objects when there are a specific number of groups with the same number of objects in each group. Multiplication requires students to think in terms of groups of things rather than individual things. Students learn that the multiplication symbol 'x' means "groups of" and problems such as 5×7 refer to 5 groups of 7.

A major conceptual hurdle in working with multiplicative structure is understanding groups of items as single entities while also understanding that a group contains a given number of objects (Clark & Kamii, 1996). Students can solve the problem "How many apples are in 4 baskets of 8 apples each?" by counting out four sets of eight counters and then counting them all. To think multiplicatively about this problem as four sets of eight requires students to conceptualize each group of eight as a single item to be counted. Experiences with making and counting equal groups, especially in contextual situations, are extremely useful. (From: Van de Walle, *Teaching Student-Centered Mathematics*, Vol. II 3-5, page 111)

Task Directions:

Act 1 – Whole Group - Pose the conflict and introduce students to the scenario by showing Act I picture. (Dan Meyer <http://blog.mrmeyer.com/2011/the-three-acts-of-a-mathematical-story/>)
“Introduce the central conflict of your story/task clearly, visually, viscerally, using as few words as possible.”

- Show Act 1 picture to students.
- Ask students what they noticed in the picture, what they wonder about, and what questions they have about what they saw in the picture. Do a think-pair-share so that students have an opportunity to talk with each other before sharing questions with the whole group.
- Share and record students’ questions. The teacher may need to guide students so that the questions generated are math-related.



Anticipated questions students may ask and wish to answer: (*Main question(s) to be investigated)

- How many egg cartons are there altogether?
- *How many eggs are in the stack?
- How many eggs are in one layer of the tower?
- Once students have their question, ask the students to estimate answers to their questions (think-pair-share). Students will write their best estimate, then write two more estimates – one that is too low and one that is too high so that they establish a range in which the solution should occur. Students should plot their three estimates on an empty number line. Note: As the facilitator, you may choose to allow the students to answer their own posed questions, one question that a fellow student posed, or a related question listed above. For students to be completely engaged in the inquiry-based problem solving process, it is important for them to experience ownership of the questions posed.

Important note: Although students will only investigate the main question(s) for this task, it is important for the teacher to not ignore student generated questions. Additional questions may be answered after they’ve found a solution to the main question, or as homework or extra projects.

Act 2 – Student Exploration - Provide additional information as students work toward solutions to their questions. (Dan Meyer <http://blog.mrmeyer.com/2011/the-three-acts-of-a-mathematical-story/>)
“The protagonist/student overcomes obstacles, looks for resources, and develops new tools.”

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Georgia Standards of Excellence Framework
GSE The Relationship Between Multiplication and Division • Unit #2

- During Act 2, students decide on the facts, tools, and other information needed to answer the question(s)(from Act 1). When students decide what they need to solve the problem, they should ask for those things. It is pivotal to the problem solving process that students decide what is needed without being given the information up front.
- Required Information:
 - 12 eggs per carton
 - 3 cartons per layer
 - 16 layers of cartons
- The teacher provides guidance as needed during this phase. Some groups might need scaffolds to guide them. The teacher should question groups who seem to be moving in the wrong direction or might not know where to begin. Questioning is an effective strategy that can be used, with questions such as:
 - What is the problem you are trying to solve?
 - What do you think affects the situation?
 - Can you explain what you've done so far?
 - What strategies are you using?
 - What assumptions are you making?
 - What tools or models may help you?
 - Why is that true?
 - Does that make sense?

Act 3 – Whole Group – Share solutions and strategies.

- Students to present their solutions and strategies and compare them.
- Reveal the solution.
 - 16 layers of cartons
 - 3 cartons in each layer
 - 12 eggs in each carton
- Lead discussion to compare these, asking questions such as:
 - How reasonable was your estimate?
 - Which strategy was most efficient?
 - Can you think of another method that might have worked?
 - What might you do differently next time?

Act 4, The Sequel - “The goals of the sequel task are to a) challenge students who finished quickly so b) I can help students who need my help. It can't feel like punishment for good work. It can't seem like drudgery. It has to entice and activate the imagination.” Dan Meyer
<http://blog.mrmeyer.com/2013/teaching-with-three-act-tasks-act-three-sequel/>

For Act 4, share ideas below or reference other student-generated questions that could be used for additional classwork, projects or homework.

Examples (also see Extensions):

- Each carton costs \$2.00. How much does the whole tower cost?

FORMATIVE ASSESSMENT QUESTIONS

- What models did you create?
- What organizational strategies did you use?

DIFFERENTIATION

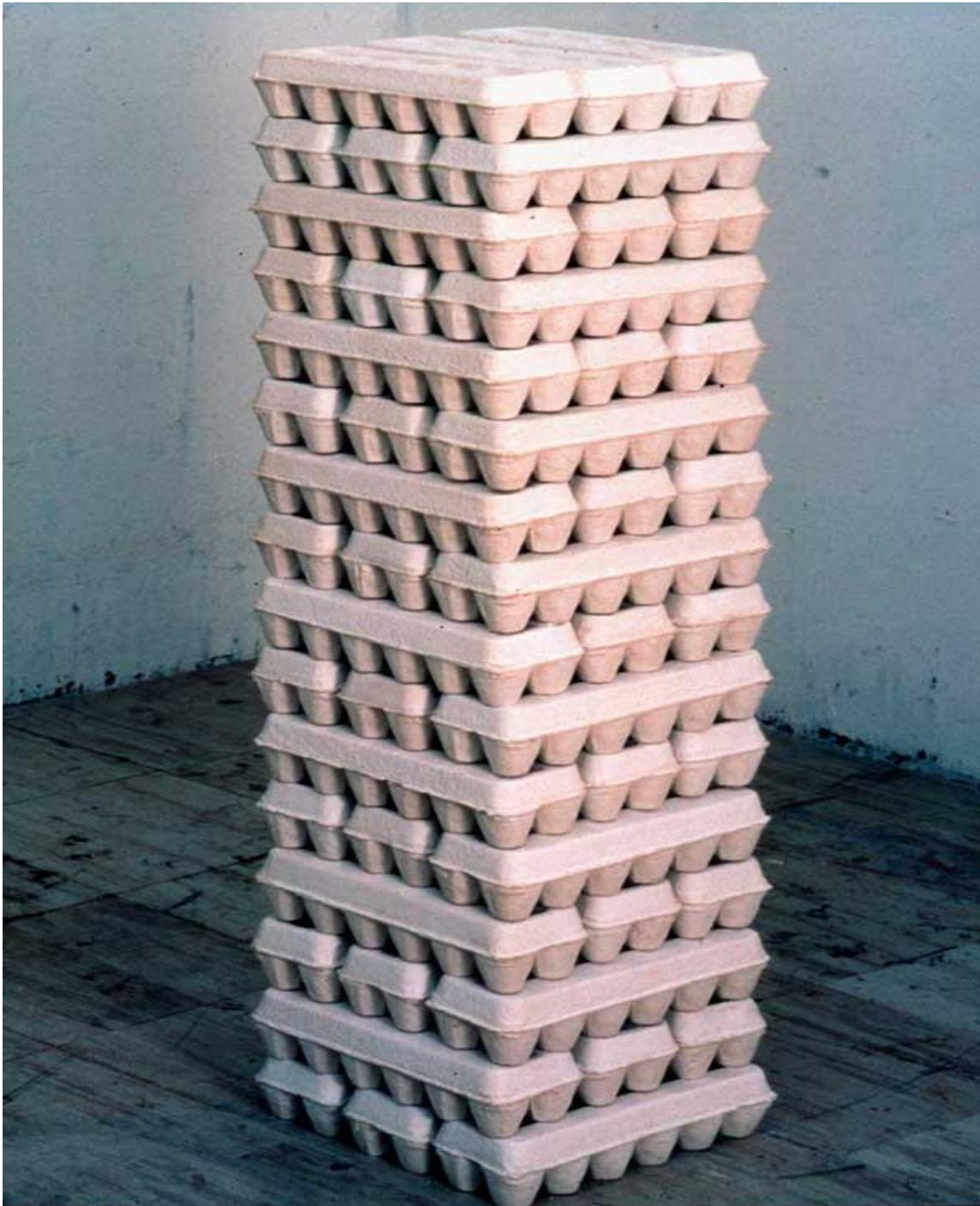
Extension

- Allow students to build their own egg carton towers (using drawings or manipulatives), and determine the total number of eggs in the tower.
- Provide students with a number of cartons (ex. 63 cartons), and require students to design a tower using that many cartons. Students should answer how many eggs are in their tower as well as how many layers (groups) of cartons they have and how many in each layer (group). Similarly, you could provide students with a number of eggs and require them to design a tower that holds that many eggs.

Intervention

- Use visual representations of the groups of eggs in each carton.

Act 1 Picture:



Task Title: _____

Name: _____

Adapted from Andrew Stadel

ACT 1

What did/do you notice?

What questions come to your mind?

Main Question: _____

What is your 1st estimate and why?

On an empty number line, record an estimate that is too low and an estimate that is too high.

ACT 2

What information would you like to know or need to solve the MAIN question?

Record the given information (measurements, materials, etc...)

If possible, give a better estimation with this information: _____

Act 2 (con't)

Use this area for your work, tables, calculations, sketches, and final solution.

ACT 3

What was the result?

PRACTICE TASK: ARRAY-NGING OUR FACT FAMILIES

In this task, students will make models on grid paper of arrays that show both multiplication and division number sentences. This task makes important connections between multiplication and division. Students will become familiar with division as the inverse operation of multiplication as they learn that the numbers in a multiplication sentence can also be used in a related division sentence.

APPROXIMATE TIME: 1 Day

CONTENT STANDARDS

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.

Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.) Use arrays, area models, and manipulatives to develop understanding of properties.

MGSE3.OA.6. Understand division as an unknown-factor problem.

For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8. Conversations should also include connections between division and subtraction.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

(Information quoted from Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades 3-5, pages 62-63)

“Students can benefit from a few activities with models and no context. The purpose of such activities is to focus the meaning of the operation and the associated symbolism.

Make sure to draw students’ attention to the dimension of the rectangles (length and width). You want students to make the connection that the factors in the multiplication expression they have written indicate the number of rows and columns (the dimensions) in a rectangle that consist of the given number of squares.”

COMMON MISCONCEPTION

Students may have difficulty seeing multiplication and division as inverse operations. In order to develop an understanding of this relationship, students need to have ample opportunities to explore these two operations simultaneously.

ESSENTIAL QUESTIONS

- How are multiplication and division related?
- How can the same array represent both multiplication and division?

MATERIALS

- Grid paper
- Colored pencils or markers
- “Array-ning Our Fact Families” recording sheet

GROUPING

Individual/Partner Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See *Minilessons for Early Multiplication and Division* by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2, 3, 4, 5, 6, 7, and 8)

PART 1

Give students 12 blocks that represent the total area of an array. Have them arrange the blocks in an array and identify the dimensions of their array, noting different arrays are possible for 12. Then ask if there is a way they can make a division sentence with the dividend represented by the total area of the array. For example, a student may make a 4 x 3 array. The dividend (area of 12) can be divided by 4 or 3, both factors of 12. Both dimensions are utilized, one as the divisor and the other as the quotient.

PART 2

Task Directions

Students will follow the directions below from the “Array-ning Our Fact Families” recording sheet.

1. Draw the following arrays:
6 by 3
4 by 8
2 by 7
2. Use the example to complete the following for each array:
 - Label the dimensions and total area.
 - Write a multiplication sentence and tell the factors and the product.
 - Write a division sentence and indicate the divisor, dividend, and quotient.
3. Select one of your arrays and write two story problems that can be modeled with the array, one for multiplication and one for division.

FORMATIVE ASSESSMENT QUESTIONS

- How can you describe your array?
- How does the array show both multiplication and division?
- What does the word “by” mean (i.e. 6 by 3)?
- What is the difference between a factor and a product? With what operation would you use these words?
- Explain the meaning of the divisor, dividend, and quotient in a division sentence?

DIFFERENTIATION

Extension

- Have students build an array of their choice and have a partner describe the dimensions and area of the array and all related vocabulary relating to both multiplication and division.
- Have students build arrays for multiplication and division that involve larger numbers. Limit the dimensions to a three-digit number times a one-digit number.

Intervention

- If students are not ready to transition to grid paper without the use of the base-ten blocks, allow the use of these manipulatives to guide student work.

TECHNOLOGY CONNECTION

- http://www.eduplace.com/math/mw/background/3/08/te_3_08_overview.html
This site provides background information on the relationship between multiplication and division.

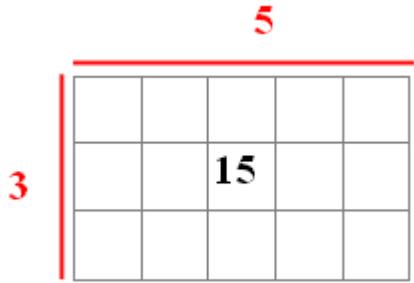
Name _____ Date _____

Array-ning Our Fact Families



This 3 by 5 array has a total of 15 square units.
 $3 \times 5 = 15$.

3 and 5 are **factors**.
 15 is the **product**.



Fifteen divided by three equals five.
 $15 \div 3 = 5$
 15 is the **dividend**.
 3 is the **divisor**.
 5 is the **quotient**.

1. Draw the following arrays listed in the table below.
2. Following the example above, complete the following for each array:
 - Label the dimensions and total area.
 - Write a multiplication sentence and label the factors and the product.
 - Write a division sentence and label the divisor, dividend, and quotient.

6 by 3	4 by 8	2 by 7
--------	--------	--------

3. Select one of your arrays. On the back of this paper, write two story problems that can be modeled with the array, one for multiplication and one for division.

SCAFFOLDING TASK: FINDING FACTORS

APPROXIMATE TIME: 3-4 Days

CONTENT STANDARDS



MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.¹¹

Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.) Use arrays, area models, and manipulatives to develop understanding of properties.

MGSE3.OA.6. Understand division as an unknown-factor problem.

For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8. Conversations should also include connections between division and subtraction.

MGSE3.OA.7 Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that $8 \times 5 = 40$, one knows $40 \div 5 = 8$) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE/ COMMON MISCONCEPTIONS

(Information quoted from Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades 3-5, page 64)

“Students look for patterns in the factors they find for numbers, such as the number of factors, the type of factors, the shape of the resulting array, and so on. Rather than always assigning numbers that have several factors, this activity suggests including numbers that have only a few factors so that differences between numbers become more distinct.”

¹¹ Students need not use formal names for these properties.

Make sure to draw student’s attention to the dimensions of the rectangles (length and width). You want students to make the connections that the factors in the multiplication expression they have written indicate the number of rows and columns (the dimensions) in a rectangle that consist of the given number of squares. Your class will undoubtedly want to decide if a rectangle that is 3 by 8 should be counted differently from one that is 8 by 3. Leave the decision to the class but take advantage of the opportunity to discuss how 3 rows of 8 are the same as 8 rows of 3. Note that if sets rather than arrays are made, 3 sets of 8 look very different from 8 sets of 3.

ESSENTIAL QUESTIONS

- How can multiplication products be displayed on a multiplication chart?
- What strategies can be used to find factors or products?
- How does the order of the digits in a multiplication problem affect the product?

MATERIALS

Part I:

- Square tiles
- Finding Factors with Arrays Student recording Sheet

Part II:

- Counters
- Blank Multiplication chart
- Right angle guide (on colored card stock)
- Colored card stock cut out or Paper dessert plates or coffee filters or index cards
- Finding Factors Using Equal Sets Student Recording Sheet (will also use for Multiplication Chart Mastery Task)

GROUPING

Small Group/Partner

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2 3, 4, 5, 6, 7, and 8)

Part I:

Begin the lesson by writing $6 \times 4 = 24$ on the board/overhead/smart board. Ask three volunteers to label the two factors and the one product. Discuss and review the terms from the task before to ensure retention. You may do a few together then ask the students to write their favorite multiplication sentence (expression) on their desk/wipe off board/ paper and label. Circulate and check for comprehension.

Next, write a large 24 on the board. Ask the class to think if there is one factor, or more than one factor for the number 24. Is there more than 1? 2? Ask for three predictions for how many factors there are for the number 24. After taking the predictions, use square tiles (square magnets, square image on the smart board) to have students model their thinking. Have three sets of 24 prepared and ask three volunteers (or have a set for each student/pair of students) and ask them to create an array using the 24 tiles. Show the student where and how to label the length and width. Share the results. Discuss commutative property. Decide, as a class, if 4×6 and 6×4 are the same. If they did not find all the factors, prompt to see if they can find more ways. There are four arrays for 24: 1×24 or 24×1 , 2×12 or 12×2 , 3×8 or 8×3 and 4×6 or 6×4 . Students can draw and label the different arrays on the board. Identify the factors and the product. Students can then record the different arrays for the product 24 on their Finding Factors with Arrays Student Response Sheet.

Part II:

Divide the students into pairs or small groups of mixed abilities. Prepare stations (you may need multiple) with bags of 12, 18, 30 and 36 square tiles. Allow the students to create arrays for each product. They may draw and label the arrays on their Finding Factors Student Recording Sheet. Circulate and encourage with questions such as: Is there another way to create an array with your product? How many factors do you think your product will have? Is there a difference between these two arrays? Can you explain why these arrays are/aren't different?

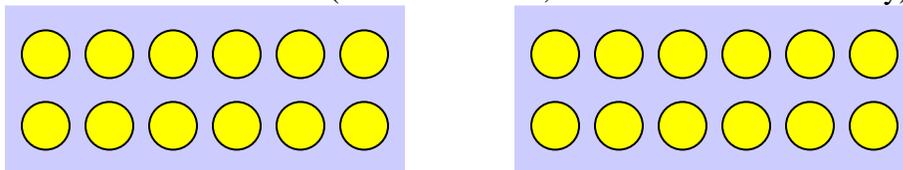
Conclude with sharing the arrays and discuss the student's findings. End the lesson with reviewing factors and products.

Part III:

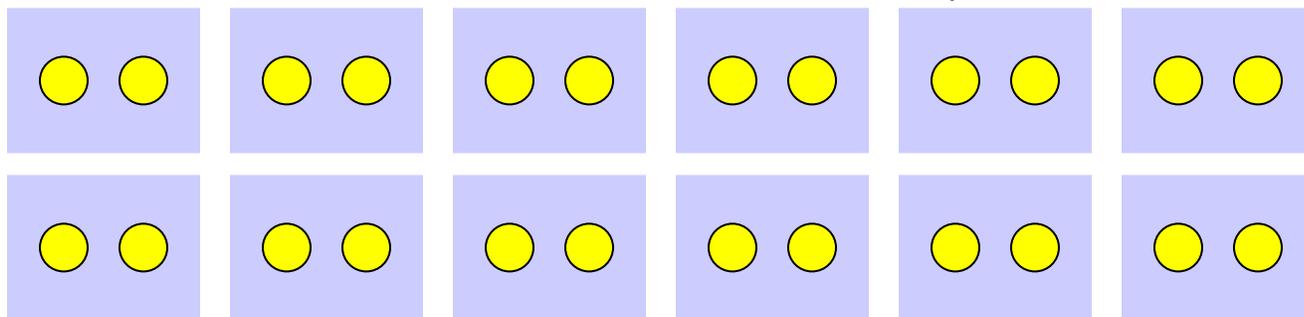
Find Factors using Equal Sets Student Recording Sheet to build the multiplication chart.

Students will continue to build on the concept of factors and products using counters and index cards/coffee filters/ paper dessert plates or the cut out from the right angle guide. The teacher will model with the number 24. Using two sets of 24 counters (one for each student or you can choose to use the smart board) the teacher will ask two volunteers to bring their Student Response Sheet from yesterday. These students will decide on one multiplication fact whose product is 24. For example, the students choose $2 \times 12 = 24$ or $12 \times 2 = 24$. Each student selects a factor and receives that amount of cards (index, cut out from right angle guide, coffee filter, paper dessert plate) and 24 counters. Ask each student to evenly divide the counters onto each card. Ask each student to use math language to create a division sentence and multiplication sentence for their model.

Student 1: Choose Factor 2 (receives 2 cards, divides 24 counters evenly)



Student 2: Choose Factor 12 (receives 12 cards, divides 24 counters evenly)



As a class discuss who has 2 groups of 12 and who has 12 groups of 2. Provide time to discuss if this is the same or different and why. Discuss the commutative property and the relationship that multiplication has with division. Repeat with new volunteers and the remaining factors for 24. Create and record the multiplication expressions and corresponding division sentences for the factors of 24. Discuss what the division sentences have in common. (The product from the multiplication expression is first in the division sentence.)

Divide the students into pairs or small groups of mixed abilities. Prepare stations (you may need multiple) with bags of 12, 18, 30 and 36 counters and up to 36 index cards (coffee filters, cut outs, paper dessert plates). Allow the small groups or partners to go to each station to model the different factors using the counters and index cards (or what you have chosen to be the designated grouping). They may draw and label grouping on their Finding Factors Student Recording Sheet from the previous task (if the students are working the same groups as Part 1 or new sheets for today's grouping). Circulate and encourage with questions like:

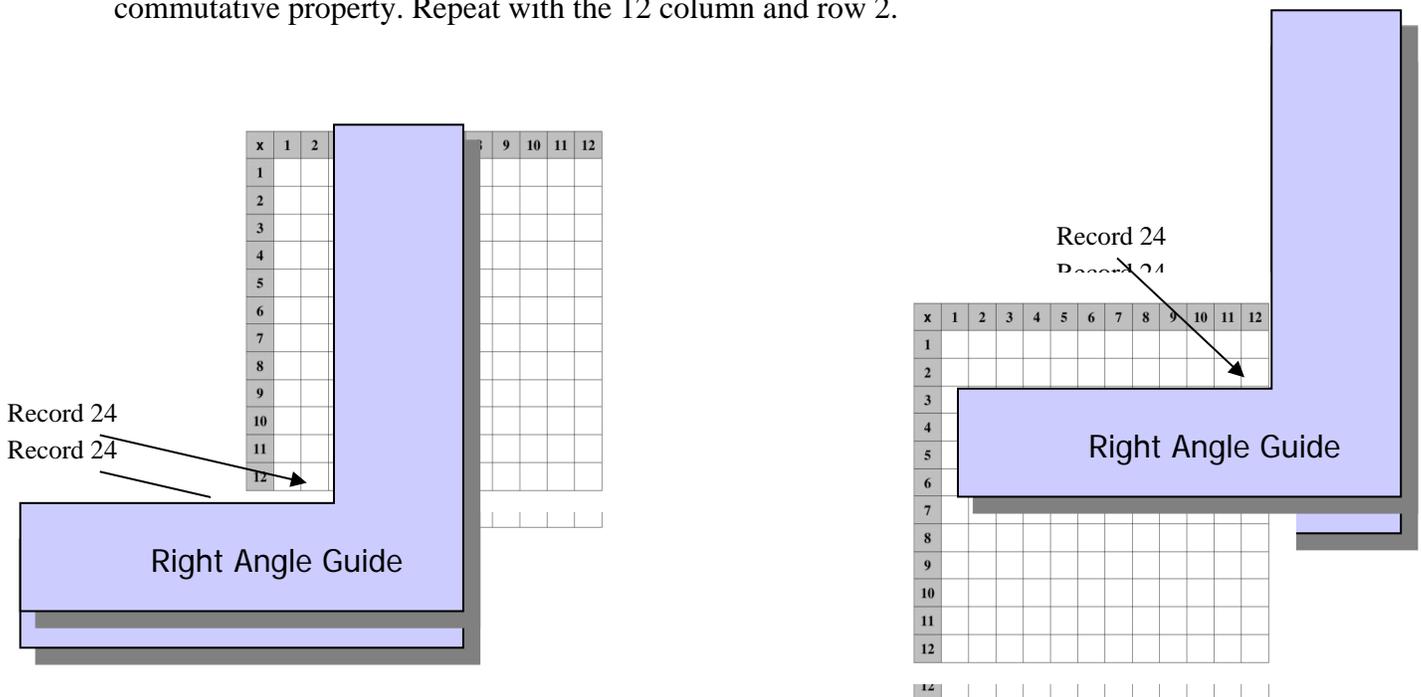
- *Is there another way to create a multiplication sentence with your product?*
- *How many factors do you think your product will have?*
- *Is there a difference between these two facts?*
- *Can you explain why or why not these facts are different?*
- *What does the division sentence look like?*
- *What do you notice about how you arranged the division sentence?*

Part IV

Building the Multiplication Chart using the factors from the numbers 12, 18, 24, 30 and 36.

Today the students will begin recording the products on the multiplication chart. The teacher will demonstrate using a whole class setting or may choose to use a small group setting while students are finishing work from Part I or Part II. Students will use the student response sheets from both days or they may choose to use one strategy.

Starting with the 2 the teacher will line up the vertical Right Angle Guide with the two columns. Ask the class what was the other factor that is multiplied with 2 to get the product 24. Find the row with 12 and line up the horizontal Right Angle Guide. This will show the student where to write the product 24 in the multiplication chart. Discuss with the class or small group the commutative property. Repeat with the 12 column and row 2.



Continue to complete the factors of 24 as a class or with the small group. Circulate and check for comprehension. The students may work in pairs or individually to complete the facts for 12, 18, 30 and 36.

FORMATIVE ASSESSMENT QUESTIONS

- How can multiplication products be displayed on a multiplication chart?
- What strategies can be used to find factors or products?
- How does the order of the digits in a multiplication problem affect the product?
- How does a division sentence use the factors and product from a multiplication expression?

DIFFERENTIATION

Extension

- Provide the student with larger numbers to determine factors
- Provide the student with odd numbers, lead to discussion of remainders (although the understanding and interpreting remainders is not necessary in Third Grade, they naturally occur in most contexts and would be a great lead into MGSE.4.OA).

Intervention

- Provide the student with one of the two factors
- Provide the student with two factors to determine the product using one strategy
- Focus on one strategy in both lessons
- Some students will need to fill every box within the multiplication chart.
- For a visual, see the Square of Pythagoras-
<http://moosehuntress.blogspot.com/2011/03/square-of-pythagoras-first-presentation.html>

Georgia Department of Education
Georgia Standards of Excellence Framework
GSE The Relationship Between Multiplication and Division • Unit #2

NAME _____

DATE _____

Multiplication Chart

x	1	2	3	4	5	6	7	8	9	10	11	12
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

NAME _____

DATE _____

Finding Factors with Arrays
Student Recording Sheet



Directions:

Record as many arrays you can for each number given.
Label each array with factor, factor and product.

Product 12

Product 18

Product 24

Product 30

Product 36

PRACTICE TASK: SHAKE, RATTLE, AND ROLL REVISITED

In this task, students will roll two cubes to get factors and use factors to find the product.

CONTENT STANDARDS

MGSE3.OA.1. Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5×7 .*

MGSE3.OA.2 Interpret whole number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares (How many in each group?), or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each (How many groups can you make?). *For example, describe a context in which a number of shares or a number of groups can be expressed as $56 \div 8$.*

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Students are taught to write equations as early as Kindergarten. Variables and equations are powerful tools in representing mathematical ideas. In this task students are able to use all of their strategies to figure out products, quotients, and factors. (Teaching Student-Centered Mathematics, John A. Van de Walle and LouAnn H. Lovin, 2006).

COMMON MISCONCEPTIONS

Students may have the misconception that they must find the product using one particular strategy or all multiplication strategies they have learned. It is important for students to be able to pick a strategy that makes sense to them and that they are able to use proficiently. This task allows them to practice multiplication strategies and develop efficient ways to solve multiplication problems.

ESSENTIAL QUESTIONS

- What strategies can be used to solve multiplication problems?
- How does the order of the digits in a multiplication problem affect the product?
- What is the relationship between the factors and the product?

MATERIALS

- drawing paper, blocks, any other materials that will help students visualize the problem
- “Shake Rattle and Roll” student game board
- 2 dice

GROUPING

Partners

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 6, and 8)

Each player takes turns and rolls the number cubes and covers the product or any two factors of the product. For example, if a player rolls a 2 and an 8, the player could cover 16 (product), 2 (factor), or 8 (factor). If the product and factors have been covered, the player loses a turn. The first player to cover five squares in a row vertically, horizontally or diagonally wins the game. This same concept can be used to practice division facts following the same concept. However, change the numbers on the game board, focus on the divisor, dividend, and quotient.

FORMATIVE ASSESSMENT QUESTIONS

- What multiplication are you using?
- What patterns are you noticing?

DIFFERENTIATION

Extension

- Create game boards with larger numbers using 9 sided dice.

Intervention

- Provide students with manipulatives to form arrays with their two factors in order to find the products.



Shake, Rattle and Roll Revisited

Directions: Each player takes turns and rolls the number cubes and covers the product or any two factors of the product. If the product and factors have been covered, the player loses a turn. The first player to cover five squares in a row vertically, horizontally or diagonally wins the game. To practice division facts follow the same concept however, change the numbers on the game board, focus on the divisor, dividend, and quotient.

24	4	9	3	18	2	20	12	4
4	1	20	12	4	3	25	5	8
2	3	6	4	30	36	1	5	18
4	9	1	18	6	5	16	1	9
25	20	4	25	3	2	5	4	8
5	12	2	1	15	12	6	18	5
24	3	24	8	3	5	4	24	2
15	8	6	9	36	3	18	6	24
8	5	16	25	2	30	6	2	3

Shake, Rattle and Roll Revisited (0-9)

Directions: Each player takes turns and rolls the number cubes and covers the product or any two factors of the product. If the product of factors has been covered, the player loses a turn. The first player to cover five squares in a row vertically, horizontally or diagonally wins the game. To practice division facts follow the same concept however, change the numbers on the game board, focus on the divisor, dividend, and quotient.

24	4	27	49	18	63	20	12	45
35	21	64	12	28	7	25	14	0
2	48	6	54	30	36	21	72	18
16	9	45	18	35	48	16	1	32
72	20	7	54	3	10	27	4	8
40	12	42	1	15	12	6	32	5
24	14	36	8	4	5	56	24	63
15	0	6	9	36	42	18	56	24
81	28	16	40	2	30	6	10	3



SCAFFOLDING TASK: USE WHAT YOU KNOW

In this task, students use multiplication facts and strategies to identify the unknown factor in a division problem. Students will then answer the provided word problems and create two of their own.

CONTENT STANDARDS

MGSE3.OA.6. Understand division as an unknown-factor problem. For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8. Conversations should also include connections between division and subtraction.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

(Information quoted from Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades 3-5, page 123)

This missing-factor approach is likely to be invented by some students if they are solving measurement problems such as the following: “Grace can put 6 pictures on one page of her photo album. If she has 82 pictures, how many pages will she need?” Alternatively, you can simply pose a task such as $82 \div 6$ and ask students, “What number times 6 would be close to 82?” and continue from there.

This task requires students to label parts of a division problem. Whereas memorizing terminology and definitions is not required, mathematical language should be used in every lesson.

COMMON MISCONCEPTIONS

Students may have difficulty seeing multiplication and division as inverse operations. In order to develop an understanding of this relationship, students need to have ample opportunities to explore these two operations simultaneously.

ESSENTIAL QUESTIONS

- How are multiplication and division related?
- How is division an unknown factor problem?

MATERIALS

- Unknown Factor Record sheet
- Counters
- Index cards

GROUPING

Partner/Independent

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See *Minilessons for Early Multiplication and Division* by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Using multiplication facts and a strategy of choice, students identify the unknown factor in a division problem. Students will also record and label parts of a division problem in both formats. Students will then answer the provided problems as well as create two of their own.

To begin, distribute one index card to each student. Ask them to write one multiplication problem, including the product on the card. (You may want to assign tables, rows, groups etc different numbers. For example one group writes different 4s facts, another writes different 6s facts.) Collect the cards. Choose one card from the stack. Reserve the rest of the stack for partner/independent practice.

Part I: (SMP 1, 2, 3, 4, 6, and 8)

Write the known fact on the board/overhead/smart board. Discuss the fact and how it can be solved. (Check retention of strategies). Create a story problem from the fact. For example if the fact is $4 \times 7 = 28$, the story problem could be “28 people are riding the roller coaster. There are four people in each row. How many rows are in the roller coaster?”

Provide students (individually or at work groups) counters and blank index cards. Ask them to count out 28 counters (Great opportunity to discuss different strategies to count out 28 counters using counting by twos, threes, fours).

Next, ask the students to identify the other given number in the problem. Discuss what has to happen next. Ask for suggestions on how to divide 28 into groups of four. Will they need four index cards to represent the roller coaster rows? Will they need to count out four roller coaster riders and put them on an index card to represent each row? Discuss with the class which model would correctly show the problem? Ask if there are any other strategies the students could have used to solve this problem.

Ask, what multiplication problem do we already know that could help us solve this story problem? Discuss, “Well, if we know $4 \times 7 = 28$, how can we use this fact to find the answer to the problem? Write the division equation and discuss the reasoning.

After the division equation has been written, introduce or reintroduce the parts of a division equation; divisor, dividend and quotient. Label the correct parts.

$$28 \div 4 = 7$$

Dividend is 28
Divisor is 4
Quotient is 7

$$\begin{array}{r} 7 \\ 4 \overline{) 28} \end{array}$$

Repeat, using the student-made multiplication problems from the beginning of the lesson. Teacher, can provide a few story problems and then challenge the class to create more. Always give the product and one factor to create the story problem. Work with volunteers using the counters and index cards to model solutions for the group. Make sure to discuss what known multiplication fact could have been used to solve the story problem. Write the division sentence and label the parts. Allow time and encourage students to share how they solved the story problem.

Part II: (SMP 1, 2, 3, 4, 6, 7, and 8)

Same day or on the second day, distribute the Unknown Factor Recording Sheet. The students can be in partners, working groups or individual. Complete the first problem as a class. Let the students use the counters and index cards to model their math thinking. Allow time for them to explain. Discuss methods used to solve the unknown factor. Label the parts of the problem together. Complete the second as a class or allow students to complete on their own or with partners. After enough time for the students to come up with an answer, call the class back and discuss strategies used to find the unknown factor. Check student work and labeling. Continue as partners to solve the final problems.

Part III: (SMP 1, 2, 3, 4, 5, 6, and *)

On the second or third day, hang or place the student written multiplication facts around the room. On the back of the Unknown Factor Recording sheet, have the students divide it into four sections. Each pair (or individual) will tip toe to a multiplication problem somewhere in the room. They must write their own unknown factor problem using the format the class practiced. Instruct them to write the multiplication problem. Write the unknown factor story problem. Write the division equation that solves the problem and label the parts of the division equation. Repeat until the partners or individual has four different unknown factor problems written. Have counters and index cards available if students would like to use them. Finally, ask for students to share the unknown factor problem they have created and how they solved it. Discuss strategies used. Students can also challenge a class mate to solve their unknown factor problem and model it using the counters and index cards. Extension: collect student record sheets and create a follow up task or station using the student created unknown factor problems.

FORMATIVE ASSESSMENT QUESTIONS

- What strategy can you use to solve an unknown factor problem?
- Describe how multiplication and division are alike.

DIFFERENTIATION

Extension:

- Students can create story problems that have a two step process.

Intervention:

- Students may use manipulatives or multiplication chart

Name _____

Date _____

Unknown Factor Stories
Student Record Sheet



Directions:

1. Use the known multiplication facts to solve the unknown factor problem.
2. Write a division equation that solves the problem.
3. Label the parts of the division equation (Dividend, Divisor, Quotient)

Bonus: Write and label both ways to write a division equation

I know $10 \times 7 = 70$. How can I use that fact to find the answer to this problem?

Mr. Adams bought 70 new notebooks for the class. There were 10 notebooks in each package. How many packages did Mr. Adams buy?

I know $4 \times 6 = 24$. How can I use that fact to find the answer to this problem?

Janey would like to put 24 pictures of her friends in a photo album. She can put 4 pictures on each page. How many pages in the photo album will have pictures of her friends on them?

I know $2 \times 4 = 8$. How can I use that fact to find the answer to this problem?

PetSmart has 8 hamsters. How many hamsters will fit in 4 cages?

I know $5 \times 7 = 35$. How can I use that fact to find the answer to this problem?

It took Sam 35 minutes to run each lap. If Sam ran 7 laps, how long did each lap take?

I know $6 \times 8 = 48$. How can I use that fact to find the answer to this problem?

Tanya spent \$48 at Old Navy. She bought eight new shirts at the same price. What was the price of each shirt?

I know $3 \times 9 = 27$. How can I use that fact to find the answer to this problem?

Kim spent \$27 on candy for her nine friends. How much did Kim spend on each friend?



PRACTICE TASK: MULTIPLICATION CHART MASTERY

In this task, students will explain and describe the patterns they find in the multiplication chart. This task would work well as a math conference interview. Consider using it as an assessment during the year, adding, deleting or changing questions as well as parts of the chart to uncover students' thinking and learning.

APPROXIMATE TIME: 2 days to complete

CONTENT STANDARDS

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.

Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.) Use arrays, area models, and manipulatives to develop understanding of properties.

MGSE3.OA.6. Understand division as an unknown-factor problem.

For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8. Conversations should also include connections between division and subtraction.

MGSE3.OA.7 Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that $8 \times 5 = 40$, one knows $40 \div 5 = 8$) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

When learning about multiplication, students need a wide variety of experiences and opportunities to explore and discover patterns on their own. Students need a good understanding of how to read rows and columns on a multiplication chart and how to find products using the chart as a tool. Students should also have an understanding of the commutative property.

COMMON MISCONCEPTIONS

Students may have the interpretation that they must fill in the multiplication chart from memory. It is important to be sure to make manipulatives available to students who may need them.

As students discover and verbalize patterns in the multiplication chart, they find more strategies with which to remember multiplication and division facts. The more familiar students become with patterns and predicting successive numbers in patterns, the better prepared they will be for further understanding.

ESSENTIAL QUESTIONS

- What patterns of multiplication can we discover by studying a times table chart?
- How can we determine numbers that are missing on a times table chart by knowing multiplication patterns?

MATERIALS

- “Multiplication Chart Mastery” recording sheet
- Manipulatives
- Blank Multiplication Chart (partially filled in from Finding Factors Task)

GROUPING

Individual/Small group

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Students may have the interpretation that they must fill in the multiplication chart from memory. It is important to be sure to make manipulatives available to students who may need them.

As students discover and verbalize patterns in the multiplication chart, they find more strategies with which to remember multiplication and division facts. The more familiar students become with patterns and predicting successive numbers in patterns, the better prepared they will be for further understanding.

Part I: (SMP 1, 2, 5, 6, 7 and 8)

Students may begin to fill in their own multiplication chart. Challenge them to fill in the facts they know. Discuss what patterns they discover. How will they find the products they are missing?

Part II: (SMP 1, 2, 3, 6, 7 and 8)

Students will answer the questions on the “Multiplication Chart Mastery” recording sheet. Be sure to give students an opportunity to discuss their answers with peers and the teacher.

FORMATIVE ASSESSMENT QUESTIONS

- What patterns do you notice in the ___ column?
- If you think of 8×4 as 8×2 doubled, what is the product of 8×4 ? Will this strategy always work? How do you know?
- What strategy could you use to find the products for the eight facts?
- Where are examples of the commutative property on the multiplication chart?

DIFFERENTIATION

Extension:

- Have a student fill in a multiplication chart and purposely include six wrong items. Trade with a partner and try to be the first to identify the incorrect numbers on the chart and make corrections.

Intervention:

- Provide students with a partially filled in multiplication chart. Be sure to strategically fill in the chart based on the student’s needs.



Name _____

Date _____

Multiplication Chart Mastery

1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18			27	30
4	8	12	16	20	24			36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36			54	60
7	14		28	35		49		63	70
8	16			40			64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

1. Mike filled in this chart to practice his multiplication facts. Which fact does he seem to know best?

How do you know?

2. Mike has all his nines facts correct, even though he has not memorized them. Explain one strategy he might have used to fill in his nines on the chart.

3. Mike is missing some of threes and fours facts. Fill them in for him and explain how you would teach him to find these answers.

4. How could Mike use the fours facts to help him find the eights facts? Fill those in for him and explain your strategy.

5. Mike has done a great job filling in all the numbers on the diagonal. What do you notice about these numbers?

6. Do you see any other patterns on the multiplication chart? Describe at least one.

7. Explain how the commutative property helps you fill in facts on the multiplication chart. Give an example.

CONSTRUCTION TASK: MAKING THE “HARD” FACTS EASY

In this task, students will practice using the distributive property.

APPROXIMATE TIME: 2 class sessions



CONTENT STANDARDS

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.

Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.)

Use arrays, area models, and manipulatives to develop understanding of properties.

MGSE3.OA.7 Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that $8 \times 5 = 40$, one knows $40 \div 5 = 8$) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

(Information quoted from Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades 3-5, page 113)

For multiplication, the ability to break numbers apart in flexible ways is even more important than in addition or subtraction. The distributive property is another concept that is important in multiplication computation. For example, to multiply 43×5 , one might think about breaking 43 into 40 and 3, multiplying each by 5, and then adding the results. Children require ample opportunities to develop these concepts by making sense of their own ideas and those of their classmates.

Third grade students will not be required to use the distributive property for products greater than one hundred.

COMMON MISCONCEPTIONS

When using the distributive property to solve problems, students will partition numbers and arrays at different points. It is important for students to decide the appropriate way to partition a number, instead of the teacher, so that the problem makes sense to them.

ESSENTIAL QUESTIONS

- How does understanding the distributive property help us multiply large numbers?
- What are strategies for leaning multiplication facts?

MATERIALS

- Connecting cubes (bags of 100)
- Graph paper
- Making the Hard Facts Easy Recording Sheet
- Crayons or colored pencils
- Scissors
- Glue

GROUPING

Small Group (Part 1)

Partners or Independent (Part 2)

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Part I (SMP 1, 2, 3, 4, 6, 7, and 8)

(Students should be divided into small mixed ability groups)

Discuss with students that in order to make “hard” multiplication number sentences easier, they can use an easier multiplication fact. (Allow groups to discuss) Record or let students come up and record the “easy” multiplication facts on the board/overhead or smart board. Discuss why these are easy. (“Easy” multiplication facts consist of but are not limited to 1s, 2s, 5s, 10s).

Understanding that this is an opinion question, allow this to be an open discussion for the students in a respectful environment.

Next, discuss what the “hard” facts or facts they haven’t yet mastered are and list the numbers on the board. If there are too many, decide on the two “hardest” facts (generally 7s, 8s and 9s). With a quick show of hands, let the class decide which are the “hardest” facts. Use these facts to model for the class (For this example, the 7s facts will be used).

Distribute bags of connecting cubes to each group. Instruct the groups to build seven rows of nine using the connecting cubes OR which ever “hardest fact” your class has chosen. Follow the example using 7×9 . (But insert your factors) Arrange the seven rows of nine into an array and ask “From our knowledge of arrays, who can say the multiplication expression is represented in this array?” Correct response would be 7×9 . Acknowledge that this is one of the “hard” facts. Ask students to pick which factor they consider the hardest and to split that factor into two easier factors (ex: 7 can become $5 + 2$). Separate two rows of nine from the array you have created. What are the two arrays you have now? (Answer: 5 rows of nine and 2 rows of nine) Using our knowledge of arrays, can you find the product of each array? (5 rows of 9 is 45 and 2 rows of 9 is 18). Now, push the two arrays back together and ask “What is the total when we push together the two arrays? $45 + 18$? Answer 63 so what would be the product of 7×9 ? This is called the Distributive Property. We can break down or distribute one factor in a multiplication problem to create two expressions, and then add the products. You may repeat modeling this a second time with a different fact.

Finally, challenge the groups to use the distributive property on their own. Practice with these facts 7×8 , 7×4 and 7×3 . Circulate and check, asking groups how they distributed the one of the facts. Conclude with a class discussion about the distributive property. How does it work? Did you distribute one or both factors? What do you add together?

Part II (SMP 1, 2, 4, 6, 7, and 8)

Review one or two multiplication facts using the connecting cubes from Part 1. Discuss how the distributive property works. (Distribute one factor into two numbers from the easy facts, create the two arrays and add the products.) Encourage students to use this distributive strategy using graph paper and the Making the Hard Facts Easy recording sheet. Distribute these sheets to either partners or individuals. Model the first question. Circulate and check for comprehension of the directions. Continue to model the second question or students may complete with partners or individually.

FORMATIVE ASSESSMENT QUESTIONS

- How does the distributive property help us find the product of “hard” facts?
- When can you use the distributive property?

DIFFERENTIATION

Extension:

- Students can create their own multiplication problems to solve using the distributive strategy. (Product does not need to be greater than 100)

Intervention:

- Students can continue to use manipulatives or repeated addition



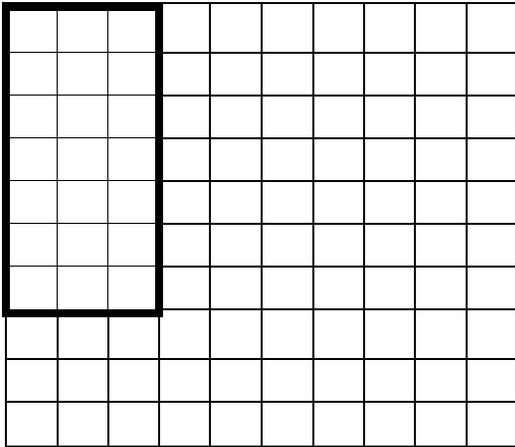
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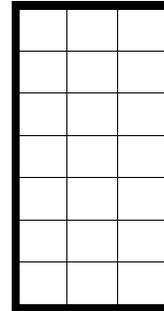
Making the "Hard" Facts Easy
 Student Recording Sheet

Example: 7×3

1. Outline 7 rows of 3 on graph paper

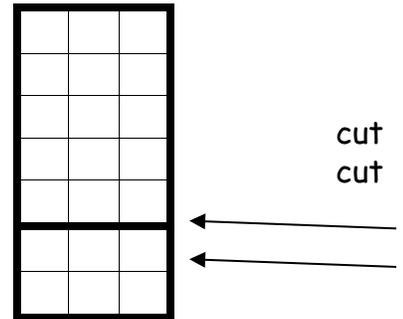


2. Cut out 7 rows of 3 from graph paper

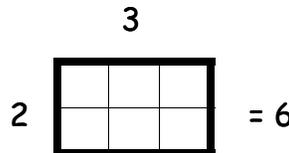
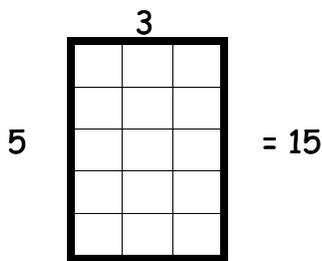


3. Record what two numbers 7 can distribute to 5 + 2 = 7

4. Cut 7 rows of 3 to be two arrays, 5 rows of 3 and 2 rows of 3



5. Paste both arrays and label.



6. Record multiplication sentences

$$5 \times 3 = 15$$

$$2 \times 3 = 6$$

$$15 + 6 = 21 \text{ so } 7 \times 3 = 21$$

Name _____

Date _____

Making the "Hard" Facts Easy
Student Recording Sheet



My "Hard" facts

Hard fact _____

1. Outline the array on graph paper.
2. Cut out the array from graph paper.
3. Record the two numbers ___ can distribute to _____ + _____ = ___.
4. Cut ___ rows of ___ to be two arrays, ___ rows of ___ and ___ rows of ___.
5. Paste both arrays and label.
6. Record multiplication sentences.



PRACTICE TASK: FIND THE UNKNOWN NUMBER

In this task, students will complete division equations by finding the unknown factors.

APPROXIMATE TIME: 1 Day

CONTENT STANDARDS

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.

Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.) Use arrays, area models, and manipulatives to develop understanding of properties.

MGSE3.OA.6. Understand division as an unknown-factor problem.

For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8. Conversations should also include connections between division and subtraction.

MGSE3.OA.7 Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that $8 \times 5 = 40$, one knows $40 \div 5 = 8$) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE AND COMMON MISCONCEPTIONS

(Information quoted from Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades 3-5, page 123)

This missing-factor approach is likely to be invented by some students if they are solving measurement problems such as the following: “Grace can put 6 pictures on one page of her photo album. If she has 82 pictures, how many pages will she need?” Alternatively, you can simply pose a task such as $82 \div 6$ and ask students, “What number times 6 would be close to 82?” and continue from there.

ESSENTIAL QUESTIONS

- How can you use multiplication facts to solve unknown factor problems?
- How are multiplication and division related?

MATERIALS

- Ten-sided dice or number cards (1-10) or playing cards Ace through 10
- Find the Unknown Number partner cards (You may want to put this in a sheet protector or laminate for reuse)

GROUPING

Partner

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2, 6, 7 and 8)

Partners will take turns rolling the ten-sided dice or choosing a card from a face down pile. If Partner 1 can use the number he/she rolled/chose to correctly complete any equation on the “Find the Unknown” partner card, they can record the number in the correct spot. Partner 2 then takes a turn. The partner to fill in the division equations correctly first wins that round. Partners can play again or switch cards with another pair of partners.

FORMATIVE ASSESSMENT QUESTIONS

- How do multiplication facts help in solving division equations?
- What strategy can you use to solve division equations?

DIFFERENTIATION

Extension:

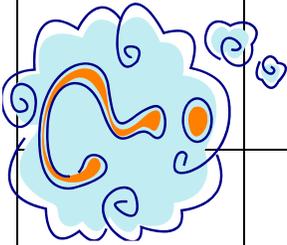
- Create a game board that has two missing components. Use number cards to 100, or use a spinner (top) on a 100s chart. (must place books on each side to keep spinner (top) on the 100s chart.

Intervention: (SMP 5)

- Allow student to use multiplication chart or reduce the amount of rounds.

Find the Unknown Number (Partner Card A)

Partner 2



$$18 \div 2 = \underline{\quad}$$

$$\underline{\quad} \div 1 = 7$$

$$8 \div 4 = \underline{\quad}$$

$$30 \div \underline{\quad} = 6$$

$$20 \div \underline{\quad} = 2$$

Partner 1

$$12 \div \underline{\quad} = 2$$

$$16 \div 4 = \underline{\quad}$$

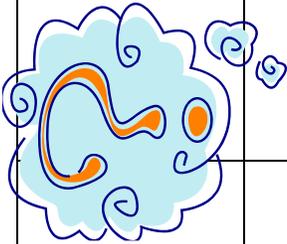
$$5 \div 5 = \underline{\quad}$$

$$18 \div \underline{\quad} = 6$$

$$\underline{\quad} \div 2 = 4$$

Find the Unknown Number (Partner Card B)

Partner 2



$$20 \div 2 = \underline{\quad}$$

$$\underline{\quad} \div 1 = 3$$

$$36 \div 4 = \underline{\quad}$$

$$36 \div \underline{\quad} = 6$$

$$16 \div \underline{\quad} = 2$$

Partner 1

$$24 \div \underline{\quad} = 6$$

$$12 \div 4 = \underline{\quad}$$

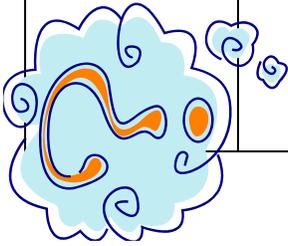
$$6 \div 6 = \underline{\quad}$$

$$60 \div \underline{\quad} = 6$$

$$\underline{\quad} \div 2 = 5$$

Find the Unknown Number (Partner Card C)

Partner 2



$$32 \div 8 = \underline{\quad}$$

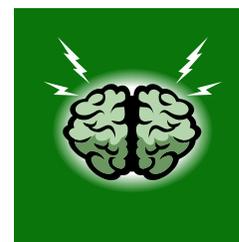
$$\underline{\quad} \div 1 = 7$$

$$16 \div 4 = \underline{\quad}$$

$$63 \div \underline{\quad} = 7$$

$$18 \div \underline{\quad} = 2$$

Partner 1	$80 \div \underline{\quad} = 8$ $32 \div 4 = \underline{\quad}$ $7 \div 7 = \underline{\quad}$ $18 \div \underline{\quad} = 6$ $\underline{\quad} \div 2 = 3$
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CONSTRUCTING TASK: MAKING UP MULTIPLICATION

In this task, students will learn three different ways a multiplication problem can be written. They will then practice writing their own problems.

APPROXIMATE TIME: 3-4 days

CONTENT STANDARDS

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.¹² Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.) Use arrays, area models, and manipulatives to develop understanding of properties.

MGSE3.OA.6. Understand division as an unknown-factor problem. For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8. Conversations should also include connections between division and subtraction.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

*****Mathematical Practices 1 and 6 should be evident in EVERY lesson.*****

BACKGROUND KNOWLEDGE

“When teaching multiplication and division, it is essential to use interesting contextual problems instead of more sterile story problems (or “naked numbers”). With a meaningful context students are more likely to exhibit their most spontaneous and meaningful approaches to solving a problem because they have some connection to it.” (From: Van de Walle, *Teaching Student-Centered Mathematics*, Vol. II, 3-5)

¹² Students need not use formal terms of these properties.

COMMON MISCONCEPTION

In part II of this task, students will begin exploring different types of multiplication word problems and begin looking at comparison problems. Comparison problems use the terms “*times as many*”. It is important for the teacher to recognize this as a comparison problem, but should not be taught as a key phrase for students to learn. Students should build their understanding of the problem by analyzing what is happening in the problem.

ESSENTIAL QUESTIONS

- What strategies can help you solve real world multiplication problems?
- How can you write a mathematical sentence to represent a multiplication model we have made?
- How can you use what you know about multiplication to help you write your own multiplication problem?

MATERIALS

- Interlocking cubes
- Number strip
- Graph paper
- Two ten-sided dice
- Index cards
- Making up Multiplication, Student recording sheet
- Wipe off boards (optional)

GROUPING

Small Group/Partners/Independent

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. See *Minilessons for Early Multiplication and Division* by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2, 3, 4, 5, 6, 7, and 8)

Part I- Small Group

Provide each group with an equivalent group/set problem. For example: There are 3 cars. Each has 2 people in it. How many people are there altogether? OR There are 6 fish bowls. Each contains 4 goldfish. How many goldfish are there altogether? OR There are 7 tables. Each table has 4 legs. How many legs are there altogether?

The students can model these and similar types of problems with:

- Interlocking cubes
- Jumps on a number strip
- Drawing a picture
- Creating an array

After the groups have solved their problems and explained their solutions, present the students with the task of making up their own story problems using the number sentence structure above with the different factors and products. The students can write their problems on index cards and swap with other groups. The students can solve the student created problem on a wipe off board or paper showing their strategies and multiplication sentences. Ask the students to label the two factors and one product in the problem. Ask for volunteers to share the problem and how they got the answers.

Did all of the student-created problems work? If some did not work due to wording or values too high, collectively decide how to adjust the problem so it is able to be solved. Return the cards to the owners. Have the owners solve their problem on the back of the index card. The students should also label the factors and product. Collect and review for accuracy and content.

Part II: Exploring different types of story problems (whole group/partners)

First, begin with comparison problems (“*times as many*”), where possible, using a context familiar to students. Brainstorm with the class and decide on three separate topics to write their comparison problems. (Possible topic: lunch, pets, toys, types of cards, pencils)

For example: Anna has 3 carrots in her lunchbox and Jessie has 3 *times as many* carrots as Anna. How many carrots does Jessie have in her lunchbox?

Have students identify the factors and product in each multiplication problem you solve with the students.

Pose a few questions to the whole group and have students solve collaboratively with their partner and then share their thinking. Ask them to pose their own problems using “*times as many*” in their problem. They can use index cards, wipe off boards or paper to present their own

problems to partners to solve. Ask the students to label the two factors and one product in the problem. Share problems, solutions and strategies used.

Next, work with several array problems (equivalent groups). Pose problems such as: The students are lined up in 3 teams. Each team has 6 members. How many students are there altogether? Identify and label the two factors and product.

Students can use graph paper, peg boards, bead strings, or interlocking cubes to create arrays to solve the problems. Students can then create their own array problem for a partner to solve. Ask the students to label the two factors and one product in the problem. Share problems, solutions and strategies used.

Next, work with unknown-factor problems. Allow students to solve a few problems working with their partners, and then ask them to pose their own problems.

If you need 1 car for 5 people, how many cars will you need for 15 people? OR If you need 1 fish bowl for 2 goldfish, how many bowls will you need for 18 goldfish? OR If each table seats 4 people, how many tables will you need for 28 people?

Now ask the students to make up word problems using the unknown-factor problem structure. They can use index cards, wipe off boards or paper to present their own problems to partners to solve. Ask the students to label the two factors and one product in the problem. They can use repeated subtraction as well as unknown-factor multiplication.

Finally, ask students to share their problems and solutions. Ask if they could write their answers using a division sign.

Part III

Use the Making up Multiplication, Student recording sheet as evaluation.

Teachers may decide to use this each day to record the student's progress by having the student create and solve the type of multiplication story problem after each session. Then use another copy to assess at the end of the task as record of performance.

- Explain one strategy you can use to solve a multiplication word problem?
- How can you find the unknown-factor in a multiplication problem?
- What is a factor?
- What is a product?

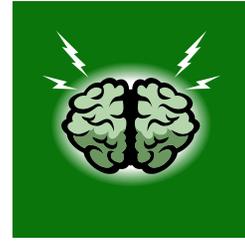
DIFFERENTIATION

Extension

- Give the student the product and ask them to find out how many different factors could be used to solve the problem. Which factors would be the most likely? Explain the reasoning and strategy used.

Intervention

- Guided practice that simulates the task, done ahead of time, will enable students to develop problem solving strategies.
- Using manipulatives instead of graph paper.
- Use Making Up Multiplication, Student Response sheet with problem already created. The student will solve the problem and label the parts of the number sentence only.



Name _____

Making up Multiplication
Student Recording Sheet

Directions:

- A) Write your own a word problem for each type.
- B) Solve the problem and show your fabulous math work.
- C) Label the parts of the number sentence.

Problem Type 1:

How many times as many: (Comparison Problem)

Problem Type 2:

Array problem (Equivalent groups problem)

Problem Type 3:

If I have..., then I need...problems (Unknown-factor problem)



Name _____

Making up Multiplication Student Recording Sheet

Directions:

- A) Write your own a word problem for each type.
- B) Solve the problem and show your fabulous math work.
- C) Label the parts of the number sentence.

Problem Type 1:

How many times as many: (Comparison Problem)

Amber has 3 stickers on her notebook, and Jill has 4 times as many stickers on her notebook. How many stickers does Jill have on her notebook?

Problem Type 2:

Array problem (Equivalent groups problem)

Rob has 5 rows of flowers in his garden. Each row has 9 flowers. How many flowers are there in all?

Problem Type 3:

If I have..., then I need...problems (Unknown-factor problem)

If you need 1 box for 6 markers, how many boxes will you need for 24 markers?



CONSTRUCTING TASK: FIELD DAY BLUNDER

In this task, students will complete a multi-step word problem.

CONTENT STANDARDS

MGSE3.OA.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.¹³ See Glossary: Multiplication and Division Within 100.

MGSE.3.OA.4 Determine the unknown whole number in a multiplication or division equation relating three whole numbers using the inverse relationship of multiplication and division. For example, determine the unknown number that makes the equation true in each of the equations, $8 \times ? = 48$, $5 = \square \div 3$, $6 \times 6 = ?$.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Depending on the student's reasoning and understanding of the problem, this could be solved using multiplication and division, but also acted out through manipulatives. Regardless of how the problem is solved, it is important that students use words, numbers, and pictures to communicate their reasoning.

COMMON MISCONCEPTION

Multiplication and division are usually taught separately. However, multiplication and division should be combined in order for students to see how they are related. "Experiences with making and counting groups, especially in contextual situations, are extremely useful. Products or quotients are not affected by the size of numbers as long as the numbers are within the grasp of the students" (Teaching Student-Centered Mathematics, 2006, John A. Van de Walle and LouAnn H. Lovin). This idea becomes evident in this task.

¹³ See glossary, Table 2.

ESSENTIAL QUESTIONS

- How can multiplication and division be used to solve real world problems?
- How can we use patterns to solve problems?

MATERIALS

- drawing paper, blocks, any other materials that will help students visualize the problem
- “Field Day Blunder” student recording sheet

GROUPING

Partners

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2, 3, 4, 5, 6, 7, and 8)

Students will follow the directions below from the “Field Day Blunder” recording sheet.

Mrs. Nelson’s third grade class was very excited about the upcoming field day events. Each third grade class was given a helmet and sacks for the upcoming sack race. Once the sack race was complete, Mrs. Nelson’s class moved on to the next race. As the students rushed to the next event, they left all of their helmets and sacks in a big pile. Christopher and Megan were left to match the helmets with the sacks. Some of the sacks were for 2 people, and some were for 3 people. There were 24 helmets in all. Christopher and Megan were able to match all of the helmets to their sacks. How many 2- and 3-person sacks could there be?

FORMATIVE ASSESSMENT QUESTIONS

- How many sacks do you think were left in the pile? How do you know?
- How did you determine the number of 2 person and 3 person sacks?
- Do you think there is more than one right solution for this task? Why do you think so? How can you find out?

Mathematics • GSE Third Grade • Unit 2: The Relationship Between Multiplication and Division

Richard Woods, State School Superintendent

July 2015 • Page 159 of 180

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DIFFERENTIATION

Extension

- Determine three different combinations of sacks and helmets.

Intervention

- Provide students with a total number of sacks.

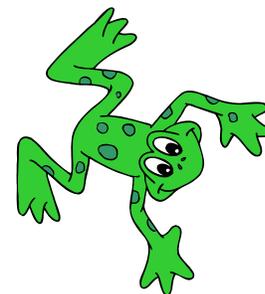


Name _____ Date _____

Field Day Blunder

Mrs. Nelson's third grade class was very excited about the upcoming field day events. Each third grade class was given a helmet and a sack for the upcoming sack race. Once the sack race was complete, Mrs. Nelson's class moved on to the next race. As the students rushed to the next event, they left all of their helmets and sacks in a big pile. Christopher and Megan were left to match the helmets with the sacks. Some of the sacks were for 2 people, and some were for 3 people. There were 24 helmets in all. Christopher and Megan were able to match all of the helmets to their sacks. How many 2- and 3-person sacks could there be? Use numbers, pictures and words to communicate your reasoning.

1. Draw pictures to show all the ways you can arrange the sacks and helmets.
2. Label and write matching number sentences for each arrangement.
3. Choose your favorite arrangement and explain why you think it would be the best arrangement so that every student has a helmet and a sack.



CONSTRUCTING TASK: LEAP FROG

(adapted from Baltimore County Public Schools)

In this task students will measure the leaps of origami frogs to the nearest inch and plot the measurement on a line plot graph.

CONTENT STANDARDS

MGSE3.MD.4. Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

BACKGROUND KNOWLEDGE

“The need to gather data will come from the class naturally in the course of discussion or from questions arising in other content areas. Science, of course, is full of measurements and thus abounds in data requiring analysis. Line plots are useful counts of things along a numeric scale. One advantage of a line plot graph is that every piece of data is on the graph.” (Teaching Student-Centered Mathematics, John A. Van de Walle and LouAnn H. Lovin, 2006). In this task students will use data gathered from frog jumps to create a line plot graph.

COMMON MISCONCEPTIONS

When studying line plots, it is important for students to realize that the x axis is always a number line. Line plots are not to be used with categorical data.

ESSENTIAL QUESTIONS

- Why are there different types of graphs?
- How do you know which type of graph is appropriate for your data?

MATERIALS

- Student recording sheet
- 3 x 5 index card
- Scissors

- Rulers
- Masking Tape
- Internet Access
- Directions for origami frog <http://www.ljhs.sandi.net/faculty/mteachworth/avid-information/origami-frog-lab-avid.pdf>

GROUPING

Individual/Partner Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

This task is designed to deepen students understanding of collecting and displaying data. In this task students will measure the leaps of origami frogs to the nearest inch and plot the measurement on a line plot graph.

Part I

Have students discuss graphs and their purpose. On the board have examples of different types of graphs third graders are responsible for learning. Have students identify each graph and discuss each graph’s purpose. Students can attach labels to graphs for a visual representation. Explain to students that they will be creating a line plot graph. Go into detail of what a line plot graph is and why it is used.

Part II

Tell students that they are going to create a line plot graph showing how far Origami Frogs jump. Have students watch a brief YouTube video about a Frog Jumping Contest to pique their interests. You can find a video of a contest on <http://www.frogtown.org/> . View video prior to lesson to make sure it is appropriate. After viewing the video have students discuss what they saw. Display data of a frog jumping contest you “attended”. Ask students how the data was gathered. Students should mention that the data is in inches. Briefly discuss measuring and using a ruler. Ask students which type of graph would best fit the data you collected from a frog jumping contest. If students do not automatically choose line plot graph, discuss the graph they chose and why it would not be appropriate and then discuss line plot graphs again.

Part III (SMP 1, 2, 5, 6, and 7)

Explain to students that they will have their own frog jumping contest by creating Origami frogs out of paper. You can find a video of how to make an origami frog on http://www.youtube.com/watch?v=luG7_nzBHjI&feature=fvo&ad=21937675894 . The video is easy, however, you may want to write some directions down for your students. Also model each fold of the frog for clarification. Give students a few minutes to practice jumping with their paper frogs. Break students into groups of four to six. Students should take turns measuring the distance the frogs jump. Each group needs masking tape to mark the starting and end point, a ruler to measure the jump, and a recording sheet. Students should not measure their own jumps. Have students follow the directions on the student recording sheet.

FORMATIVE ASSESSMENT QUESTIONS

- What parts are needed to make a complete chart, table, or graph? (title, labels, etc.)
- Why would you organize data in different ways?
- Why are graphs used to display data?

DIFFERENTIATION

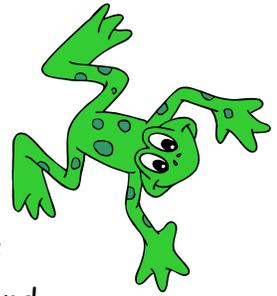
Extension

- Have students create a frog out of larger paper to see if it makes a difference in the distance the frogs jump. Have students predict the outcome.

Intervention

- Provide only inch rulers instead of rulers with multiple tick marks.

Name _____ Date _____



Leap Frog

- A. Each frog in the group will take one leap. Someone in your group will measure the distance your frog jumps. Be sure to place a piece of masking tape on the starting and end point of the jump. Use a ruler and measure the distance the frog jumps to the nearest inch. Record the distance on the chart below. Use the information collected in the table to create a group line plot graph.

Frog Owner	Distance Jumped (nearest inch)

- B. Using the data in the table above create a line plot graph for your group. Be sure to include all the elements of a line plot graph.
- C. Create a line plot graph using all the data from each group.
- D. Looking at your class data and your group data what conclusions can you draw? Were there any outliers?



CONSTRUCTING TASK: OUR FAVORITE CANDY

In this task students will collect data based their favorite candy.

CONTENT STANDARDS

MGSE3.MD.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.*

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
6. Attend to precision.

BACKGROUND KNOWLEDGE

It is important for students to be able to gather their own data about a topic that is important to them. When students formulate the questions they want to ask, the data they gather become more and more meaningful. (Teaching Student-Centered Mathematics, John A. Van de Walle and LouAnn H. Lovin, 2006). How they organize the data and the techniques for analyzing them have a purpose.

COMMON MISCONCEPTIONS

Students may read the mark on a scale that is below a designated number on the scale as if it were the next number. For example, a mark that is one mark below 80 grams may be read as 81 grams. Students realize it is one away from 80, but do not think of it as 79 grams.

Although intervals on a bar graph are not in single units, students count each square as one. To avoid this error, have students include tick marks between each interval. Students should begin each scale with 0. They should think of skip-counting when determining the value of a bar since the scale is not in single units.

ESSENTIAL QUESTIONS

- How do I decide what increment scale to use for a bar graph?
- How do you interpret data in a graph?

MATERIALS

- Chart paper/graphing paper

GROUPING

Individual/Partner Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. (See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Part I (SMP 1, 2, 4, and 6)

Review with students how to collect data using a tally chart and how to count tallies appropriately. Review the elements of a graph. Create a class graph as a model over something that is familiar to students; favorite cars, favorite game, etc.

Part II (SMP 1, 2, 3, 4, and 6)

Students follow the directions on the “Our Favorite Candy” recording sheet. Have students analyze the chart on the student recording sheet and complete the numbered tasks.

1. Organize the data by making a tally chart below to record the data.
2. Create a bar graph using the tally chart. Be sure to include a title, labels for the x and y axis, a scale, and accurate bars.
3. Write two statements that you can learn from analyzing (looking at) this data.

FORMATIVE ASSESSMENT QUESTIONS

- How do I decide what increment scale to use for a bar graph?
- How do you interpret data in a graph?
- How can I show data using a line plot graph?
- How do I decide what symbol to use when constructing a pictograph?

DIFFERENTIATION

Extension

- Have students survey a class for the same information. Have students compare the data from the original data set to the data they collected from another class.

Intervention

- Lessen the amount of data in the table in order to be more manageable for struggling students.

Name _____

Date _____



Our Favorite Candy

Ryan	Skittles
Mark	M & M's
Anthony	Gummy Bears
Sarah	Starburst
Jenise	Snickers Candy Bar
Annittra	Airheads
Janice	Skittles
Jasmine	M & M's
Teresa	Airheads
Lania	M & M's
Ronnie	Starburst
Jeremy	M & M's
Rick	Airheads
Khalil	Gummy Bears
Samantha	M & M's
Megan	Airheads
Joanie	Starburst
Kavon	Skittles
Stephanie	Skittles

1. Organize the data by making a tally chart below to record the data

2. Create a bar graph using the tally chart. Be sure to include a title, labels for the x and y axis, a scale, and accurate bars. Use your journal or another sheet of paper.

3. Write two things you can learn from analyzing (looking at) this data. Use complete sentences.



CULMINATING TASK I: MY SPECIAL DAY!

In this task, students will plan a party under \$100.

CONTENT STANDARDS

MGSE3.OA.5. Apply properties of operations as strategies to multiply and divide.¹⁴ Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.) Use arrays, area models, and manipulatives to develop understanding of properties.

MGSE3.OA.6. Understand division as an unknown-factor problem. For example, find $32 \div 8$ by finding the number that makes 32 when multiplied by 8. Conversations should also include connections between division and subtraction.

MGSE3.OA.7 Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that $8 \times 5 = 40$, one knows $40 \div 5 = 8$) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers.

STANDARDS OF MATHEMATICAL PRACTICE (SMP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

In most cases the culminating task is used as an assessment. This task is rich in SMPs as the students reason through their planning. In order to truly assess their reasoning, the teacher must circulate and conference with the students as they are planning. The Formative Assessment Questions can be used to guide these conferences. In addition to this, when students share their party planning in the end, they will have the opportunity to ask and answer questions about their planning from their peers.

¹⁴ Students need not use formal terms of these properties.

“Assessment need not look different from instruction. The typical approach of an end-of-chapter test of skills may have some value but it is not appropriate as the main method of assessment. Assessment can and should happen every day as an integral part of instruction. If you restrict your view of assessment to tests and quizzes, you will miss seeing how assessment can help students grow and inform instruction. (Van de Walle and Lovin, Teaching Student-Centered Mathematics: Grades 3-5, page 30)

“Assessment should focus on what students do know instead of what they do not know” (NCTM, 1989).”

ESSENTIAL QUESTIONS

- How is multiplication and division used to solve a problem?
- When can you use multiplication or division in real life?

MATERIALS

Planning Information sheet

GROUPING

Partner or Independent

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. See Minilessons for Early Multiplication and Division by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION (SMP 1, 2, 3, 5, 6, and 7)

Students will plan a special day, just for them! They have to keep the cost of their day under \$100. Each student will use the Planning recording sheet to decide how many guests will be invited to enjoy their special day with them. Students will figure out the cost of how much food, drinks and items they will need per guest. They have the choice of planning for a small group with a lot of items or a large group with not as many items. The goal is to see which students use multiplication and division to determine the cost of the day and which students are using repeated addition or subtraction.

FORMATIVE ASSESSMENT QUESTIONS

- How did you determine how many guests you were going to invite?
- How did you make sure that you stayed within your allotted budget?
- How did your understanding of multiplication and division help you with planning?

DIFFERENTIATION

Extension:

- Students could be challenged to create their own list of supplies using a newspaper advertisement for a local party supply store. Increase the amount of the budget for the day.

Intervention:

- Provide the amount of guests that are coming for the day and then challenge the students to figure out what they could need for their day.



Name _____

Date _____

Planning Sheet
Student Recording Sheet

You get to plan a special day just for you! Your parents are letting you pick what you want to do, eat, drink and who you will invite to share your special day with! Your task is to keep a budget under \$100. You can invite whomever you want. You get to make all the decisions!

Use the price lists to find out how much you will spend. You must use at least one item in each category.

FOOD	Cost per guest
Pizza	\$2
Hamburgers	\$2
Chicken Fingers	\$3
Ribs	\$5
Steak	\$7
Crab Legs	\$8
Japanese Steakhouse	\$10

DRINK	Cost per guest
Bottled water	\$1
Kool Aide	\$1
Lemonade	\$2
Fruit punch	\$2
Soda	\$2
Milkshakes	\$3
Root beer Floats	\$4

ACTIVITY	Cost per guest
Swimming	\$3
Roller skating	\$3
Bowling	\$4
Lazer tag	\$6
Limo ride	\$8
Waterpark	\$10
Amusement Park	\$10

FAVORS for GUESTS	Cost per guest
Stickers	\$1
Balloons	\$1
Yo yo	\$2
Frisbee	\$2
Silly string	\$2
Disposable camera	\$6
Gift card	\$10



CULMINATING TASK: ICE CREAM SCOOPS

In this culminating task, students will use multiplication and division to show different ways they can spend \$2.00 on different flavors of ice cream.

APPROXIMATE TIME: 2-3 DAYS

CONTENT STANDARDS

MGSE3.OA.1 Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each.

MGSE3.OA.2 Interpret whole number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares (How many in each group?), or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each (How many groups can you make?). For example, describe a context in which a number of shares or a number of groups can be expressed as $56 \div 8$.

MGSE3.OA.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.¹⁵ See Glossary: Multiplication and Division Within 100.

MGSE3.OA.4 Determine the unknown whole number in a multiplication or division equation relating three whole numbers using the inverse relationship of multiplication and division. For example, determine the unknown number that makes the equation true in each of the equations, $8 \times ? = 48$, $5 = \square \div 3$, $6 \times 6 = ?$.

MGSE3.MD.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. For example, draw a bar graph in which each square in the bar graph might represent 5 pets.

MGSE3.MD.4. Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

BACKGROUND KNOWLEDGE

As students begin to work on this task, they need to understand the meaning of the terms single, double, triple and double-double scoops of ice cream. The term “double-double” is another way of saying “quadruple” and you may want to ask students to explain why this is true.

If students choose to do division within this task, the conversation of remainders will naturally arise. Although remainders are not mentioned in the standards, students will encounter them

¹⁵ See glossary, Table 2.

naturally when dividing and should be addressed as they come up. These conversations will lead nicely into the fourth grade standard OA3 when the remainder must be interpreted.

ESSENTIAL QUESTION

- How do estimation, multiplication, and division help us solve problems in everyday life?

MATERIALS

- “Ice Cream Scoops” recording sheet

GROUPING

Independent Task

NUMBER TALK

By now number talks should be incorporated into the daily math routine. Continue utilizing the different strategies in number talks and revisiting them based on the needs of your students. In addition Catherine Fosnot has developed “strings” of numbers that could be included in a number talk to further develop mental math skills. See *Minilessons for Early Multiplication and Division* by Willem Uittenbogaard and Catherine Twomey Fosnot (2007).

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this culminating task, students will use multiplication and division to show different ways they can spend \$2.00 on different flavors of ice cream. In the process, they will double, triple, or quadruple the price for a single scoop of ice cream. Students can use manipulatives as needed.

Have students follow the directions on the “Ice Cream Scoops” Recording Sheet.

Part I. Picture Graph (SMP 1, 2, 4, and 6)

Using the flavors in the table, survey your classroom to see which flavor is the most liked in your class. Display your data in a picture graph. Be sure to add all elements of a picture graph.

Part II. Multiplication and Division (SMP 1, 2, 3, 4, 5, 6, 7, and 8)

The Super Delicious Ice Cream Shop has the very best ice cream in town. They sell their ice cream in double scoops, triple scoops, or double-double (that’s four) scoops. The top selling ice creams are listed on the sign below. You have \$1.00 to spend. Don’t worry about tax.

Use words, pictures, and numbers to show all your work as you answer the questions below. Think about using estimation to help you consider your choices. Be sure to show your estimation work.

Ice Cream Flavors and Prices for a Single Scoop

Varoom Vanilla	\$0.50
Cha-cha Chocolate	\$0.10
Cheery Cherry	\$0.20
Rockin' Rocky Road	\$0.30
Striped Strawberry	\$0.17
Kid's Delight	\$0.12

1. With \$1.00, which flavor can you buy, triple Varoom Vanilla, or triple Cheery Cherry? Would you have any money left?
2. To spend most of your money, should you buy a double, triple, or double-double scoop of Rockin' Rocky Road? How much money would you have left?
3. Which ice cream flavors can you buy if you order a double-double scoop?
4. On a different day, you and 5 of your friends decide to all order a double scoop of Cha-Cha Chocolate. How much money will the group spend in all?
5. You have been saving pennies for a whole month! You have saved 96 pennies. If you and two of your friends share the pennies fairly, how many pennies will each of you have to buy ice cream? Which flavor could you buy and how many scoops can you get?

FORMATIVE ASSESSMENT QUESTIONS

- What strategies are you using to help you solve this task?
- What math facts would help you solve this problem?
- Can you use an inverse operation to be sure your solution is correct?

DIFFERENTIATION

Extension

- Have students make up their own flavors and prices, use different amounts of money, and write their own Ice Cream Scoops stories to share with their classmates.

Intervention

- While fluency with multiplication facts is required of third graders, it is not required that all facts will be acquired in the second marking period of the school year. You may want to allow students to use cueing devices like a times table chart during this performance assessment as needed.

Name _____ Date _____

Ice Cream Scoops

The Super Delicious Ice Cream Shop has the very best ice cream in town. They sell their ice cream in double scoops, triple scoops, or double-double (that's four) scoops. The top selling ice creams are listed on the sign below. You have \$1.00 to spend. Don't worry about tax.

Use words, pictures, and numbers to show all your work as you answer the questions below. Think about using estimation to help you consider your choices. Be sure to show your estimation work.



Ice Cream Flavors and Prices for a Single Scoop

Varoom Vanilla	\$0.50
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Kid's Delight	\$0.12

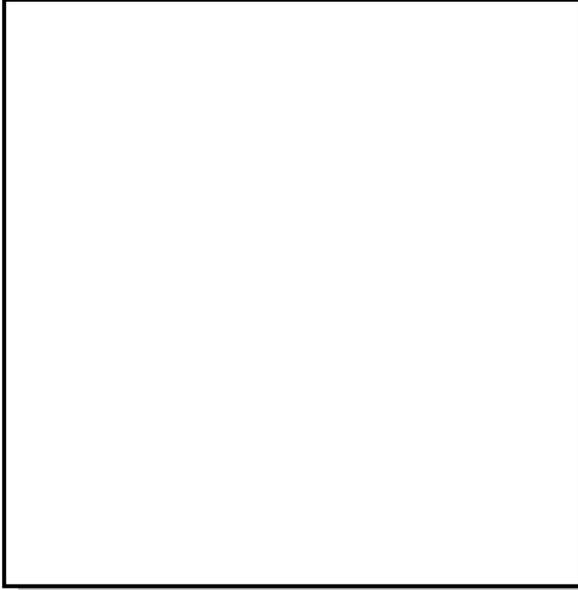
Part I. Picture Graph

Using the flavors in the table, survey your classroom to see which flavor is the most liked in your class. Display your data in a picture graph. Be sure to add all elements of a picture graph.

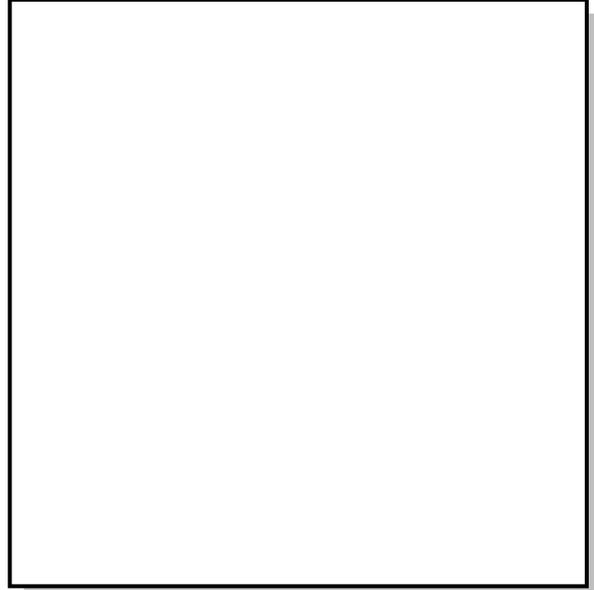
Part II. Multiplication and Division

1. With \$1.00, which flavor can you buy, triple Varoom Vanilla, or triple Cheery Cherry? Would you have any money left?

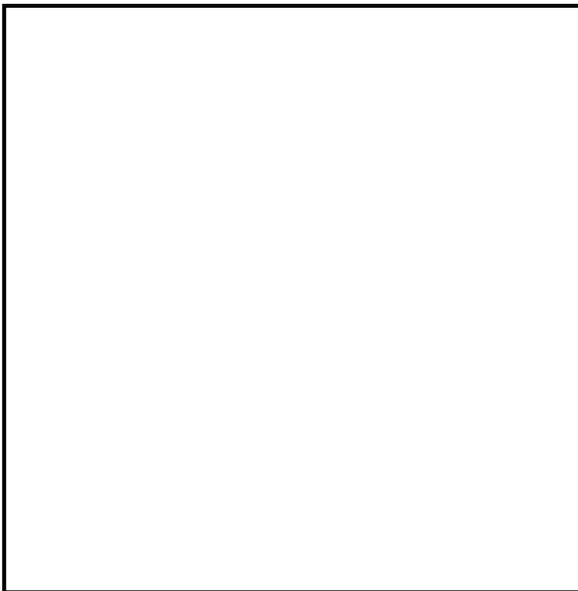
2. To spend most of your money, should you buy a double, triple, or double-double scoop of Rockin' Rocky Road? How much money would you have left?



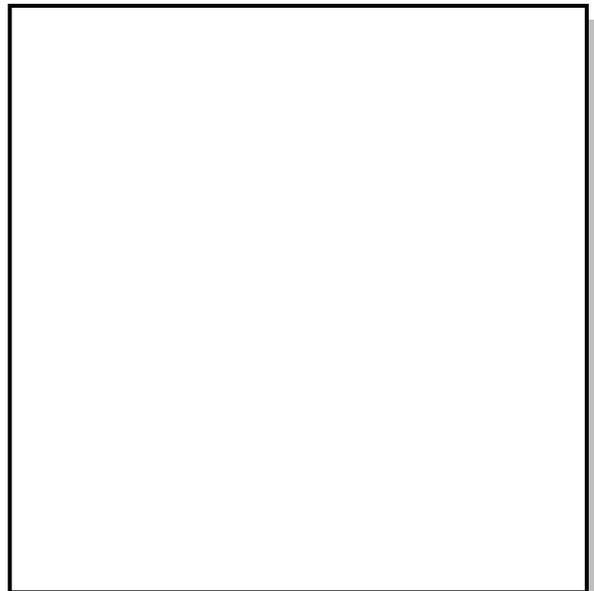
3. Which ice cream flavors can you buy if you order a double-double scoop?



5. On a different day, you and 5 of your friends decide to combine your money. You have \$10.00 total. You all want to order the same ice cream in a double scoop. Which flavors are you able to buy?



4. You have been saving pennies for a whole year! You have saved 96 pennies. If you and two of your friends share the pennies fairly, how many pennies will each of you have to buy ice cream?



3rd Grade Unit 2 Performance Assessment Rubric

Standard ↓	Exceeding	Meeting	Not Yet Meeting
MGSE3.OA.1 Interpret products of whole numbers, e.g., interpret 5×7 as the total number of objects in 5 groups of 7 objects each	<ul style="list-style-type: none"> – Multiplication work shows use of diagrams, words, and/or other suitable representations for demonstrating mastery – Evidence of estimation is shown with explanations 	<ul style="list-style-type: none"> – Multiplication calculations are correct – Evidence of estimation is shown 	<ul style="list-style-type: none"> – Multiplication calculations are incorrect or omitted – No evidence of estimation
MGSE3.OA.2 Interpret whole number quotients of whole numbers, e.g., interpret $56 \div 8$ as the number of objects in each share when 56 objects are partitioned equally into 8 shares (How many in each group?), or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each (How many groups can you make?). <i>For example, describe a context in which a number of shares or a number of groups can be expressed as $56 \div 8$.</i>	<ul style="list-style-type: none"> – Work shows all division sentences correctly – Thorough explanation of remainders is given – Explanation of all the possible solutions is given with reasons for which solution is the best 	<ul style="list-style-type: none"> – Division number sentence corresponds to the question asked in word problem. – Response indicates the presence or lack of a remainder and what this indicates – Solution to division problem is correct 	<ul style="list-style-type: none"> – Division number sentence does not correspond to question – No mention is made of remainder – Solution to division problem is incorrect
MGSE3.OA.3 Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem. ¹⁶ See Glossary: Multiplication and Division Within 100.	<ul style="list-style-type: none"> – Explanations are thorough and detailed and include reasoning as well as multiple representations to support conclusions 	<ul style="list-style-type: none"> – Explanations are logical and use specific math vocabulary to describe multiplication or division process 	<ul style="list-style-type: none"> – Explanations are omitted or illogical – Explanations do not describe the process used to derive an answer to the question asked
MGSE3.MD.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. <i>For example, draw a bar graph in which each square in the bar graph might represent 5 pets.</i>	<ul style="list-style-type: none"> – All data relevant to the solutions of both multiplication and division problems are accurately recorded in an organized fashion 	<ul style="list-style-type: none"> – Work shown is organized and logically presented – Work shown supports conclusions about which ice cream to buy 	<ul style="list-style-type: none"> – Work is not shown – Work shown is disorganized, inaccurate, or fails to communicate mathematical ideas

¹⁶ See glossary, Table 2.