Georgia Standards of Excellence Curriculum Frameworks

Mathematics

GSE Fifth Grade

Unit 1: Order of Operations & Whole Numbers

Georgia Department of Education

Richard Woods, Georgia's School Superintendent

"Educating Georgia's Future"

Unit 1: Order of Operations and Whole Numbers

TABLE OF CONTENTS (*indicates a new addition)

Classroom video available for Patterns R Us and The Grass is Always Greener, here: https://www.georgiastandards.org/Georgia-Standards/Pages/Implement-Math-Task-Classroom-Videos/What-Does-it-Look-Like-When-you-Implement-a-Task.aspx

*****Please note that all changes made will appear in green**

IF YOU HAVE NOT READ THE 5th GRADE CURRICULUM OVERVIEW IN ITS ENTIRETY PRIOR TO USE OF THIS UNIT, PLEASE **STOP** AND CLICK HERE: https://www.georgiastandards.org/Georgia-Standards/Frameworks/5th-Math-Grade-Level-Overview.pdf Return to the use of this unit once you've completed reading the Curriculum Overview. Thank you.

OVERVIEW

In this unit students will:

- Solve problems by representing mathematical relationships between quantities using mathematical expressions and equations.
- Use the four whole number operations efficiently, including the application of order of operations.
- Write, evaluate, and interpret mathematical expressions with and without using symbols.
- Apply strategies for multiplying a 2- or 3-digit number by a 2-digit number.
- Develop paper-and-pencil multiplication algorithms (not limited to the traditional algorithm) for 3- or 4-digit number multiplied by a 2- or 3-digit number.
- Apply paper-and-pencil strategies for division (not the standard algorithm)
- Solve problems involving multiplication and division.
- Investigate the effects of multiplying whole numbers by powers of 10.

Note: Fluent use of standard algorithm for long division is a grade 6 standard (MGSE6.NS.2).

WRITE AND INTERPRET NUMERICAL EXPRESSIONS

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 with this cluster are: **parentheses, brackets, braces and numerical expressions.**

UNDERSTAND THE PLACE VALUE SYSTEM

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 with this cluster are: **numerical patterns, rules, power of ten.**

PERFORM OPERATIONS WITH MULTI-DIGIT WHOLE NUMBERS (Decimals are addressed in a later unit)

Students develop understanding of why division procedures work based on the meaning of base-ten numerals and properties of operations. They finalize fluency with multi-digit addition, subtraction, multiplication, and division. They apply their understandings of models for whole numbers and number notation, and properties of operations to add and subtract whole numbers. They develop fluency in these computations, and make reasonable estimates of their results. Students use the relationship between whole numbers (i.e., a finite decimal multiplied by an appropriate power of 10 is a whole number), to understand and explain why the procedures for multiplying and dividing finite decimals make sense. They compute products and quotients. 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 with this cluster are: **multiplication/multiply, division/division, products, quotients, dividends, rectangular arrays, area models, addition/add, subtraction/subtract,** (properties)-rules about how numbers work, reasoning.

Combining multiplication and division within lessons is very important to allow students to understand the relationship between the two operations. Students need guidance and multiple experiences to develop an understanding that groups of things can be a single entity while at the same time contain a given number of objects. These experiences are especially useful in contextual situations such as the tasks in this unit.

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 throughout the year. Ideas related to the eight standards of mathematical practices should be addressed continually as well. The first unit should establish these routines, allowing students to gradually enhance their understanding of the concept of number and to develop computational proficiency.

To assure that this unit is taught with the appropriate emphasis, depth, and rigor, it is important that the standards, essential questions, and formative assessment questions be reviewed early in the planning process. The tasks in these units illustrate the types of learning activities that should be utilized from a variety of sources. The amount of time that it will take to complete each task will vary. Some tasks may be completed in one class period, and others may take several days to complete. There is no expectation that every student will complete all of the tasks presented in this unit.

*For more detailed information about unpacking the content standards, unpacking a task, math routings and rituals, maintenance activities and more, please refer to the Grade Level Overview.

STANDARDS FOR MATHEMATICAL PRACTICE

This section provides examples of learning experiences for this unit that support the development of the proficiencies described in the Standards for Mathematical Practice. These proficiencies correspond to those developed through the Literacy Standards. 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 solve problems by applying their understanding of operations with whole numbers, including the order of operations. Students seek the meaning of a problem and look for efficient ways to solve it.

2. Reason abstractly and quantitatively. Students demonstrate abstract reasoning to connect quantities to written symbols and create a logical representation of the problem at hand. Students write simple expressions that record calculations with numbers and represent numbers using place value concepts.

3. Construct viable arguments and critique the reasoning of others. Students construct arguments using concrete referents, such as objects, pictures, and drawings. They explain calculations based upon models and properties of operations and rules that generate patterns. They explain their thinking to others and respond to others' thinking.

4. Model with mathematics. Students use base ten blocks, drawings, and equations to represent place value and powers of ten. They interpret expressions and connect representations of them.

5. Use appropriate tools strategically. Students select and use tools such as estimation, graph paper, and place value charts to solve problems with whole number operations.

6. Attend to precision. Students use clear and precise language, (math talk) in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to expressions, place value, and powers of ten

7. Look for and make use of structure. Students use properties of operations as strategies to add, subtract, multiply, and divide with whole numbers. They explore and use patterns to evaluate expressions. Students utilize patterns in place value and powers of ten and relate them to graphical representations of them.

8. Look for and express regularity in repeated reasoning. Students use repeated reasoning to understand algorithms and make generalizations about patterns. Students connect place value and properties of operations to fluently perform operations.

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

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

MGSE5.OA.2 Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.

MGSE5.NBT.1. Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

MGSE5.NBT.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

MGSE5.NBT.5 Fluently multiply multi-digit whole numbers using the standard algorithm (or other strategies demonstrating understanding of multiplication) up to a 3 digit by 2 digit factor.

MGSE5.NBT.6 Fluently divide up to 4-digit dividends and 2-digit divisors by using at least one of the following methods: strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations or concrete models. (e.g., rectangular arrays, area models)

BIG IDEAS

- Multiplication may be used to find the total number of objects when objects are arranged in equal groups, rectangular arrays/area models.
- One of the factors in multiplication indicates the number of objects in a group and the other factor indicates the number of groups.
- Unfamiliar multiplication problems may be solved by using, invented strategies or known multiplication facts and properties of multiplication and division. For example, $8 \times 7 = (8 \times 2) + (8 \times 5)$ and $18 \times 7 = (10 \times 7) + (8 \times 7)$.
- There are two common situations where division may be used: fair sharing (given the total amount and the number of equal groups, determine how many/much in each group) and measurement (given the total amount and the amount in a group, determine how many groups of the same size can be created).
- The dividend, divisor, quotient, and remainder are related in the following manner: dividend = divisor x quotient + remainder.
- Some division situations will produce a remainder, but the remainder will always be less than the divisor. If the remainder is greater than the divisor, that means at least one more can be given to each group (fair sharing) or at least one more group of the given size (the dividend) may be created.

ESSENTIAL QUESTIONS

- Why is it important to follow an order of operations?
- How can I effectively critique the reasoning of others?
- How can I write an expression that demonstrates a situation or context?
- How can an expression be written given a set value?
- What is the difference between an equation and an expression?
- In what kinds of real world situations might we use equations and expressions?
- How can we evaluate expressions?
- How can an expression be written?
- How does multiplying a whole number by a power of ten affect the product?
- How can estimating help us when solving multiplication problems?
- What strategies can we use to efficiently solve multiplication problems?
- How can I use what I know about multiplying multiples of ten to multiply two whole numbers?
- How can I apply my understanding of area of a rectangle and square to determine the best buy for a football field?
- How can we compare the cost of materials?
- How can estimating help us when solving division problems?
- What strategies can we use to efficiently solve division problems?
- How can I use the situation in a story problem to determine the best operation to use?
- How can I effectively explain my mathematical thinking and reasoning to others?
- How can identifying patterns help determine multiple solutions?
- How can you determine the most cost efficient arrangement?

CONCEPTS/SKILLS TO MAINTAIN

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.

- Solve multi-step word problems using four operations
- Fluently multiply and divide within 100 using strategies
- Multiply one-digit whole numbers by multiples of 10
- Multiply a whole number of up to four digits by a one-digit whole number
- Multiply two two-digit numbers
- Divide up to four digit dividends by one digit divisors
- Use number talks to reinforce properties of operations and mental computation

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: https://bhi61nm2cr3mkdgk1dtaov18-wpengine.netdna-ssl.com/wp-content/uploads/nctm-timed-tests.pdf

STRATEGIES FOR TEACHING AND LEARNING

Write and Interpret Numerical Expressions

MGSE5.OA.1
MGSE5.OA.2
Students should be given ample opportunities to explore and evaluate numerical expressions with mixed operations. Eventually this should include real-world contexts that would require the use of grouping symbols in order to describe the context as a single expression. This is the foundation for evaluating algebraic expressions that will include whole-number exponents in Grade 6.

There are conventions (rules) determined by mathematicians that must be learned with no conceptual basis. For example, multiplication and division are always done before addition and subtraction. Begin with expressions that have two operations without any grouping symbols (multiplication or division combined with addition or subtraction) before introducing expressions with multiple operations. Using the same digits, with the operations in a different order, have students evaluate the expressions and discuss why the value of the expression is different. For example, have students evaluate $5 \times 3 + 6$ and $5 + 3 \times 6$. Discuss the rules that must be followed. Have students insert parentheses around the multiplication or division part in an expression. A discussion should focus on the similarities and differences in the problems and the results. This leads to students being able to solve problem situations which require that they know the order in which operations should take place.

After students have evaluated expressions without grouping symbols, present problems with one grouping symbol, beginning with parentheses, then adding expressions that have brackets and/or braces.

Have students write numerical expressions in words without calculating the value. This is the foundation for writing algebraic expressions. Then, have students write numerical expressions from phrases without calculating them.
Using both brackets and braces (nesting symbols) isn't a fifth grade expectation but it can be taught given an explanation. However, the main emphasis in fifth grade is the use of the parenthesis.

Understand the Place Value System
MGSE5.NBT.1
This standard calls for students to reason about the magnitude of numbers. Students should work with the idea that the tens place is ten times as much as the ones place, and the ones place is $1/10^{th}$ the size of the tens place. In 4^{th} grade, students examined the relationships of the digits in numbers for whole numbers only. This standard extends this understanding to the relationship of decimal fractions, however, that will be addressed in a later unit. Refer to the grade level overview for more information. Students use base ten blocks, pictures of base ten blocks, and interactive images of base ten blocks to manipulate and investigate the place value relationships. They use their understanding of unit fractions to compare decimal places and fractional language to describe those comparisons.

Before considering the relationship of decimal fractions, students express their understanding that in multi-digit whole numbers, a digit in one place represents 10 times what it represents in the place to its right and 1/10 of what it represents in the place to its left.

When converting in the metric system, have students extend their prior knowledge of the base-ten system as they multiply or divide by powers of ten (as referenced in Units 1 and 2). Teaching conversions should focus on the relationship of the measurements, not merely rote memorization. The questions ask the student to find out the size of each of the subsets. Students are not expected to know e.g. that there are 5280 feet in a mile. If this is to be used as an assessment task, the conversion factors should be given to the students. However, in a teaching situation it is worth having them realize that they need that information rather than giving it to them upfront; having students identify what information they need to have to solve the problem and knowing where to go to find it allows them to engage in Standard for Mathematical Practice 5, Use appropriate tools strategically.
Retrieved from Illustrative Mathematics
http://www.illustrativemathematics.org/standards/k8

MGSE5.NBT.2
This standard includes multiplying by multiples of 10 and powers of 10, including 10^2 which is $10 \times 10=100$, and 10^3 which is $10 \times 10 \times 10 =1,000$. Students should have experiences working with connecting the pattern of the number of zeros in the product when you multiply by powers of 10. Students should notice the shift of the digits when multiplying by a power of 10.

Examples:

$$2.5 \times 10^3 = 2.5 \times (10 \times 10 \times 10) = 2.5 \times 1,000 = 2,500$$

Students should reason that the exponent above the 10 indicates how many places the digits are shifting (not *just* that the digits are shifting but that you are multiplying or making the number 10 times greater three times) when you multiply by a power of 10. Since we are multiplying by a power of 10 the digits seem to shift to the left when the number is actually becoming larger.

$$350 \div 10 = 35$$

$$^{350}/_{10} = 35 \qquad (350 \times {}^{1}/_{10}) = 35$$

This will relate well to subsequent work with operating with fractions. This example shows that when we divide by powers of 10, the exponent above the 10 indicates how many places the digits are shifting (how many times we are dividing by 10, the number becomes ten times smaller). Since we are dividing by powers of 10, the digits seem to shift to the right when the number is actually becoming smaller.

Students need to be provided with opportunities to explore this concept and come to this understanding; this should not just be taught procedurally.

Perform operations with multi-digit whole numbers and with decimals to hundredths
MGSE5.NBT.5
In previous grade levels, students have used various models and strategies to solve problems involving multiplication with whole numbers, so they should be able to transition to using standard algorithms effectively. With guidance from the teacher, they should understand the connection between the standard algorithm and their strategies.

Connections between the algorithm for multiplying multi-digit whole numbers and strategies such as partial products or lattice multiplication are necessary for students' understanding. The multiplication can also be done without listing the partial products by multiplying the value of each digit from one factor by the value of each digit from the other factor. Understanding of place value is vital in using the standard algorithm. In using the standard algorithm for multiplication, when multiplying the ones, 32 ones is 3 tens and 2 ones. The 2 is written in the ones place. When multiplying the tens, the 24 tens is 2 hundreds and 4 tens. But, the 3 tens from the 32 ones need to be added to these 4 tens, for 7 tens. Multiplying the hundreds, the 16 hundreds is 1 thousand and 6 hundreds. But, the 2 hundreds from the 24 tens need to be added to these 6 hundreds, for 8 hundreds.

MGSE5.NBT.6
By fifth grade, students should understand that division can mean equal sharing or partitioning of equal groups or arrays. They should also understand that it is the same as repeated subtraction, and since it's the inverse of multiplication, the quotient can be thought of as a missing factor. In fourth grade, students divided 4-digit dividends by 1-digit divisors. They also used contexts to interpret the meaning of remainders. Division is extended to 2-digit divisors in fifth grade, but fluency of the traditional algorithm is not expected until sixth grade. Division models and strategies that have been used in previous grade levels, such as arrays, number lines, and partial quotients, should continue to be used in fifth grade as students deepen their conceptual understanding of this division.

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.

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.

- **Algorithm**
- **Distributive Property**
- **Dividend**
- **Divisor**
- **Equation**
- **Exponents**
- **Expression**
- **Measurement Division (or repeated subtraction)**
- **Multiplicand**
- **Multiplier**
- **Order of Operations**

- **Partition Division (or fair-sharing)**
- **Partial Product**
- **Partial Quotient**
- **Product**
- **Properties of Operations**
- **Quotient**
- **Remainder**

COMMON CORE GLOSSARY

http://www.corestandards.org/Math/Content/mathematics-glossary/glossary

TASKS

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.
Intervention Table	The Intervention Table provides links to interventions specific to this unit. The interventions support students and teachers in filling foundational gaps revealed as students work through the unit. All listed interventions are from New Zealand's Numeracy Project.
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 Common Core 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 ***Guide to Three-Act Tasks*** on georgiastandards.org and the K-5 CCGPS Mathematics Wiki.

Task Name	**Task Type/** *Grouping Strategy*	**Content Addressed**	**Standard(s)**	**Task Description**
Order of Operations	Scaffolding Task *Small Group/Individual Task*	Deriving the rules of order of operations	MGSE5.OA.1	Evaluate expressions with symbols using 1-inch square tiles
Trick Answers	Constructing Task *Individual/Partner Task*	Order of operations	MGSE5.OA.1	Discovering rules of order of operations
Money for Chores	Constructing Task *Individual/Partner Task*	Write and evaluating expressions.	MGSE5.OA.1	Write expressions to solve equations for chores
Hogwarts House Cup	Constructing Tasks *Individual/Partner Task*	Evaluate expressions with parentheses ( ), brackets [ ] and braces { }.	MGSE5.OA.1 MGSE5.OA.2	Writing expressions to earn points for Hogwarts
Hogwarts House Cup Part 2	Practice Task *Individual/Partner Task*	Evaluate expressions with parentheses ( ), brackets [ ] and braces {}.	MGSE5.OA.1 MGSE5.OA.2	Writing expressions to earn points for Hogwarts
The Beanbag Dartboard	Performance Task *Partner/Small Group Task*	Write and evaluate expressions and equations to represent a real life situation	MGSE5.OA.1 MGSE5.OA.2	Wonderings about throwing a beanbag on a dartboard
Expression Puzzle	Practice Task *Individual/Partner Task*	Interpret Numerical Expressions	MGSE5.OA.2	Matching numeric expressions to its meaning in written words
Patterns R Us	Constructing Task *Partner/Small Group Task*	Exploring powers of ten with exponents	MGSE5.NBT.1 MGSE5.NBT.2	Power of ten and patterns
Multiplication Three in a Row	Practice Task *Small Group/Partner Task*	Multiply multi-digit numbers	MGSE5.NBT.5	Multiplication game 2-digit by 2 or 3-digit multiplication
Preparing a Prescription	CTE Task *Individual/Partner Task*	Single and double digit multiplication in a real-world context	MGSE5.NBT.5	Using multiplication to determine cost of patient's illness, and creating an invoice
Division & Interpreting Remainders	Formative Assessment Lesson (FAL) *Individual/Small Group Task*	Division and Interpreting Remainders	MGSE5.NBT.6	Formative Assessment
The Grass is Always Greener	Constructing Task *Small Group/ Individual*	Applying multiplication to problem solving situations	MGSE5.NBT.5 MGSE5.NBT.6	Determining which turf is a better deal

	Task			
Division Four in a Row	Practice Task *Partner/Small Group Task*	Divide four-digit dividends by one and two-digit divisors	MGSE5.NBT.6	Dividing numbers up to 4-digits by 1 and 2-digit divisors
Are These All 365 ÷ 15?	Constructing Task *Individual/Partner Task*	Conceptual Understanding of Division Problem Types	MGSE5.NBT.6	Analyzing three different division situations
Start of the Year Celebration	Culminating Task *Individual Task*	Write expressions which involve multiplication and division of whole numbers	MGSE5.OA.1 MGSE5.OA.2 MGSE5.NBT.5 MGSE5.NBT.6	Determining expressions for amount of tables and chairs needed for a party

If you need further information about this unit visit the GaDOE website and reference the unit webinars.
https://www.georgiastandards.org/Archives/Pages/default.aspx

***Intervention Table**

The Intervention Table provides links to interventions specific to this unit. The interventions support students and teachers in filling foundational gaps revealed as students work through the unit. All listed interventions are from New Zealand's Numeracy Project.

Cluster of Standards	Name of Intervention	Snapshot of summary or Student I can statement. . .	Materials Master
Write and interpret numerical expressions. **MGSE5.OA.1** **MGSE5.OA.2**	Order of Operations	Use a range of strategies to solve problems that involve a combination of addition, subtraction, multiplication, and division. *(You may substitute whole numbers for decimal examples.)*	MM 8-5
	Bowl a Fact	Recall basic addition, subtraction, multiplication, and division facts	
Understand the place value system. **MGSE5.NBT.1** **MGSE5.NBT.2** **MGSE5.NBT.3** **MGSE5.NBT.4**	Close to 100	Identify relative values of digits in different places.	
	Sherpa (Tensing)	Multiply by 10s, 100s, 1000s, and other multiples of 10.	MM 6-9
	Zap	Find out how many ones, tens, hundreds and thousands are in all of a whole number.	MM 4-14 MM 7-2
Perform operations with multi-digit whole numbers **MGSE5.NBT.5** **MGSE5.NBT.6**	A Little Bit More/ A Little Bit Less	Derive multiplication facts from 2, 5 and 10 times tables.	
	Animal Arrays	Derive unknown multiplication facts from known (anchor) facts.	MM 5-2 MM 6-2
	Don't Subtract - Add!	Solve subtraction problems by using addition (for help with division).	
	Fun with Fives	Derive multiplication facts from 2, 5 and 10 times tables.	MM 4-5
	Multiplication Smorgasbord	Solve multiplication and division problems by using place value and compensation strategies.	
	Multiplication Madness	Find the product of 3 single-digit numbers using strategies.	MM 4-16
	Cut and Paste	Solve multiplication and division problems by using proportional adjustment	MM 6-5

Scaffolding Task: Order of Operations

Back to Task Table

Approximately 1Day

STANDARDS FOR MATHEMATICAL PRACTICE

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.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

BACKGROUND KNOWLEDGE

Students have solved two step word problems using the four operations in third grade and multi-step equations in 4^{th} grade. Therefore, the understanding of order or operations within the four operations should have been mastered. At the 5^{th} grade level students are now exploring these four operations within parentheses and brackets. This standard builds on the expectations of third grade where students are expected to start learning the conventional order. Students need experiences with multiple expressions that use grouping symbols throughout the year to develop understanding of when and how to use parentheses, brackets, and braces. In this unit, students use these symbols with whole numbers only.

COMMON MISCONCEPTIONS:

Students may think that all operations must be done in order from left to right. For example, students who are taught to follow PEMDAS may think that multiplication must be done before division. Use of scientific calculator to verify answers may help students to realize the importance of following the conventional order of operations.

ESSENTIAL QUESTIONS

- Why is it important to follow an order of operations?

MATERIALS:

- Color Tiles (100 per group)
- paper (1 sheet per group)
- pencils (1 per group)

GROUPING

Small group or individual

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Comments: The order of operations makes the language of mathematics more universal. Knowing these rules helps students to communicate more accurately as they gain fluency in manipulating symbolic relationships. The sequence for the order of operations is listed below.
1. Calculate inside parentheses.
2. Multiply and divide in order, from left to right.
3. Add and subtract in order, from left to right.

Students should derive the rules for order of operations on their own during the task.

In this task, students will understand why order of operations is necessary versus solving equations from left to right, and how parentheses are used within order of operations.

Task

To begin the lesson:
1. Write $3 + 4 \times 4$ on the board. Have students start by laying down 3 tiles. Then have students add a 4-by-4 array. **Ask:** How many tiles are shown in the model?
2. Have students show $3 + 4$ using a different color of tile for each addend. Then have the students build an array to show this quantity times four. **Ask:** How many tiles are shown in the model?
3. Have the students discuss the two models they have constructed. Students will then discuss and journal how the two models are different? Have students write an expression to represent each model.
4. Have students discuss what order the operations in each expression were evaluated. Students will then discuss why this order was necessary versus solving from left to right in the way that we read.

Task in groups of 4:
Jay brought some juice boxes to soccer practice to share with his teammates. He had 3 single boxes and 4 multi-packs. There are 6 single boxes in each multi-pack. To determine how many boxes of juice Jay brought to practice, evaluate $3 + 4 \times 6$.
Introduce the problem. Then have students do the activity to solve the problem. Distribute color tiles, paper, and pencils to students. Explain that the order of operations provides rules for simplifying expressions. Have students discuss possible solutions and the order in which solutions were evaluated. Ask students……should these be a rule?

FORMATIVE ASSESSMENT QUESTIONS

- Why did you multiply first (for 3 + 4 x 6 in the task)?
- What will you do to try to figure out if the answer given is correct?
- How will you demonstrate that it is correct?

DIFFERENTIATION

Extension

- To explore the complexities of order of operations, have students create and solve their own numerical expressions and defend their solutions in writing.
- Give students a number and ask them to create complex expressions equivalent to the number. Encourage students to continually expand the expression as shown below:
  17
  10 + 7
  (2 x 5) + 7
  [2 x (30 ÷ 6)] + 7
  [2 x (15 x 2 ÷ 6)] + 7

Intervention

- Provide more opportunities for students to explore order of operations using color tiles
- **Intervention Table**

TECHNOLOGY CONNECTION

- http://www.nzmaths.co.nz/resource/four-fours-challenge?parent_node This link provides teachers with some additional, student-centered lessons to develop the concept of order of operations.

Constructing Task: Trick Answers

Back to Task Table

STANDARDS FOR MATHEMATICAL PRACTICE

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.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

BACKGROUND KNOWLEDGE

Students have solved two step word problems using the four operations in third grade and multi-step equations in 4th grade. Therefore, the understanding of order or operations within the four operations should have been mastered. At the 5th grade level students are now exploring these four operations within parentheses and brackets.

COMMON MISCONCEPTIONS:

Students may think that all operations must be done in order from left to right. For example, students who are taught to follow PEMDAS may think that multiplication must be done before division. Use of scientific calculator to verify answers may help students to realize the importance of following the conventional order of operations

ESSENTIAL QUESTIONS

- Why is it important to follow an order of operations?
- How can I effectively critique the reasoning of others?

MATERIALS

- Trick Answer recording sheet
- Accessible manipulatives

GROUPING:

Partner or individual task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:

In this task, students analyze a mock work sample to demonstrate and explain their understanding of the order of operations.
Comments: Students should have an understanding of the order of operations through several problem solving experiences before being given this task. Teachers can adjust this task based upon the level of independence of their students with order of operations. For example, parenthesis can be added to or removed from any of the problems. Also, it is possible to do this task multiple times in order to introduce new order of operations concepts.

TASK:

Students will use the recording sheet to critique the answers on Sasha's homework. They will share their thinking, and discuss why Sasha might have missed the answer.

FORMATIVE ASSESSMENT QUESTIONS

- What will you do to try to figure out if the answer given is correct?
- How will you demonstrate that it is correct?
- How will you convince Sasha when you think her answer is incorrect?
- How can you explain your math reasoning clearly to your peers and teachers?
- What strategies are you using to analyze the given problems?
- What cues are you using to recognize the correct order of operations?

DIFFERENTIATION

Extension

- To explore the complexities of order of operations, have students create and solve their own numerical expressions and defend their solutions in writing.
- Give students a number and ask them to create complex expressions equivalent to the number. Encourage students to continually expand the expression as shown below:
  17
  $10 + 7$
  $(2 \times 5) + 7$
  $[2 \times (30 \div 6)] + 7$
  $[2 \times (15 \times 2 \div 6)] + 7$
- Create or add real life situations to expressions with more than 1 operation.
- Create an expression from a real life situation involving more than one operation.

Intervention

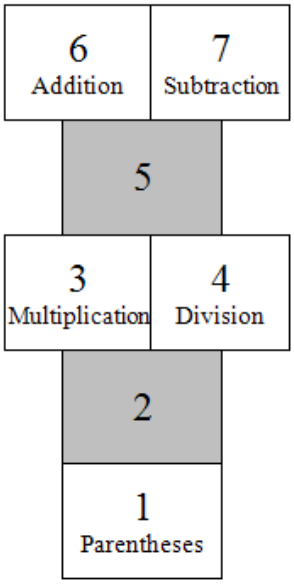
- Help students who lack background knowledge in understanding these concepts by limiting the number of operations and introducing them one at a time.
- Teach students to group operations using the parentheses, even when they are not included in the original problem. For example, if they see this problem:

$6 + 5 \times 10 - 4 \div 2$

They can rewrite it like this:

$6 + (5 \times 10) - (4 \div 2)$

In this way, the parentheses guide their work.



- Using a Hop Scotch board like the one shown on the right is one way to help students remember the order of operations. Remembering the rules of Hop Scotch, one lands with both feet on squares 3 & 4 and 6 & 7. This is used as a reminder to students that multiplication and division computed in the order in which they appear in the problem, left to right. The same is true for addition and subtraction, which is also performed in the order of appearance, left to right.
- **Intervention Table**

TECHNOLOGY CONNECTION

- http://www.nzmaths.co.nz/resource/four-fours-challenge?parent_node This link provides teachers with some additional, student centered lessons to develop the concept of order of operations.

Name _____ Date _____

Trick Answers

You and your best friend, Sasha, sat down after school at your house to work on your math homework. You both agreed to work out the problems and check each other's work for mistakes. Here is Sasha's homework paper. She didn't show her work, but she did list her answers to each problem. Check her work for her and explain to her how you know her answers are correct or incorrect.

Sasha

Order of Operations Homework

1. $6 + 2 \times 4 = 32$ _____

_____

_____

1a. If Sasha were to incorporate parentheses within her problem, where would she place them? _____

2. $24 - 8 + 6 \div 2 = 11$ _____

_____

_____

_____

3. $30 \div (10 + 5) \times 3 = 24$ _____

_____

_____

4. $3 \times (18 - 3) + (6 + 4) \div 2 = 50$ _____

_____

_____

Constructing Task: Money for Chores

Back to Task Table

Approximately 1 day

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.
6. Attend to precision.
8. Look for and express regularity in repeated reasoning.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

BACKGROUND KNOWLEDGE

Students are not expected to find all possible solutions, but ask students who are able to find one solution easily to try to find all possible solutions (but don't tell students how many solutions there are). Through reasoning, students may recognize that it is not possible to earn $40 and paint more than 5 doors because $8 \times 5 = 40$. Since the payment for one door is equal to the payment for two windows, every time the number of doors is reduced by one, the number of windows painted must increase by two. Alternately, students may recognize that the most number of windows that could be painted is 10 because $4 \times 10 = 40$. Therefore, reducing the number of window by two allows students to increase the number of doors painted

COMMON MISCONCEPTIONS

Students may choose the wrong operation because they don't fully understand the meaning of each of the four operations. Reviewing contexts for each operation before doing this activity may be helpful.

ESSENTIAL QUESTIONS

- How can I write an expression that demonstrates a situation or context?
- How can an expression be written with a given a set value?

MATERIALS

- "Money from Chores" student recording sheet

GROUPING

Partner or individual task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:

Comments

Before photocopying the students recording sheet for this task, consider if students need the table. The table may limit students' approaches to this problem.

To introduce this task, the problem could be shared with the students and they could be asked to write the expression for the problem. After it is clear that all students have the correct expression for the problem, allow students to work on finding solutions for the problem in partners or small groups.

As student competency increases, teacher support for tasks such as these should decrease. This level of student comfort with similar tasks only comes after many experiences of successful problem solving and all students will not reach it at the same time.

Scaffolding Activity

Number Tricks:

Have students do the following sequence of operations:

- Write down any number.
- Add to it the number that comes after it.
- Add 9
- Divide by 2.
- Subtract the number you began with.

Now you can "magically" read their minds. Everyone ended up with 5!

The task is to see if students can discover how the trick works. If students need a hint, suggest that instead of using an actual number, they use a box to begin with. The box represents a number, but even they do not need to know what the number is. Start with a square. Add the next number □ + (□ + 1) = 2□ + 1. Adding 9 gives 2□ + 10. Dividing by 2 leaves □ + 5. Now subtract the number you began with, leaving 5.

Task Directions

Students will follow the directions below from the "Money from Chores" student recording sheet.

Manuel wanted to save to buy a new bicycle. He offered to do extra chores around the house. His mother said she would pay him $8 for each door he painted and $4 for each window frame he painted. If Manuel earned $40 from painting, how many window frames and doors could he have painted?

1. Write an algebraic expression showing how much Manuel will make from his painting chores.

2. Use the table below to find as many ways as possible Manuel could have earned $40 painting window frames and doors.

w	*d*	Work Space	Amount of Money Earned
0	5	4(0) + 8(5) = 0 + 40	$40
2	4	4(2) + 8(4) = 8 + 32	$40
4	3	4(4) + 8(3) = 16 + 24	$40
6	2	4(6) + 8(2) = 24 + 16	$40
8	1	4(8) + 8(1) = 32 + 8	$40
10	0	4(10) + 8(0) = 40 + 0	$40

3. Did you find all of the possible ways that Manuel could have painted windows and doors? How do you know?

FORMATIVE ASSESSMENT QUESTIONS

- What strategy are you using to find a solution(s) to this problem?
- How could you organize your thinking/work when solving this problem? Why is that an effective strategy?
- Did you find all of the ways to solve this problem? How do you know?
- Were you able to find all possible solutions to the problem?

DIFFERENTIATION

Extension

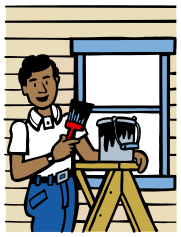
- How many windows and doors could he have painted to earn $60? $120? For some students, the problem can be changed to reflect the earnings of $60 or $120 before copying.

Intervention

- Some students may benefit from solving a similar but more limited problem before being required to work on this problem. For example, using benchmark numbers like 10 and 50, students could be asked how many of each candy could be bought with $1, if gumballs are 10¢ each and licorice strings are 50¢ each.
- **Intervention Table**

Name _____ Date _____

Money from Chores



Manuel wanted to save to buy a new bicycle. He offered to do extra chores around the house. His mother said she would pay him $8 for each door he painted and $4 for each window frame he painted.

If Manuel earned $40 from painting, how many window frames and doors could he have painted?

1. Write an expression showing how much Manuel will make from his painting chores.

2. Use the table below to find as many ways as possible Manuel could have earned $40 painting window frames and doors.

Windows	Doors	Work Space	Amount of Money Earned

3. Did you find all of the possible ways that Manuel could have painted windows and doors? How do you know?

Constructing Task: Hogwarts House Cup

Back to Task Table

Approximately 3 days

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.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

MGSE5.OA.2 Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.

BACKGROUND KNOWLEDGE

Students have solved two step word problems using the four operations in third grade and multi-step equations in 4^{th} grade. Therefore, the understanding of order or operations within the four operations should have been mastered. At the 5^{th} grade level students are now exploring these four operations within parentheses and brackets.

COMMON MISCONCEPTIONS

There are many ways to show multiplication symbolically. Before doing this task, teachers should review the different multiplication symbols such as the one shown in problem 4 on the student worksheet.

ESSENTIAL QUESTIONS

- What is the difference between an equation and an expression?
- In what kinds of real world situations might we use equations and expressions?

MATERIALS

- "Hogwarts House Cup, Year 1" student recording sheet, 2 pages

GROUPING

Partner/Small Group Task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Students explore writing expressions and equations as well as simplifying expression in the context of points earned at Hogwarts. This task should be carried over several class periods as these ideas are developed.

Comments

This task could be introduced by reading short passages from one of the Harry Potter books where points are given or deducted or when the students are sorted into houses. See the "Technology Connection" below for links to websites with a lot of information on these topics.

This task is broken into three parts. Each part builds on the understanding from the part before it. It is best to do the parts in order. Be sure to facilitate discussion of math reasoning, which is critical to the understanding of the algebraic concepts presented.

Students may require some additional practice with the ideas presented in each part of this task. Use formative assessment data to guide your decision regarding how much practice students need with each part of the task.

This task can be used as a learning task or an alternative would be to use the individual parts of the task as formative assessment tools to measure student understanding of algebraic concepts.

Task Directions

Students will follow the directions below from the "Hogwarts House Cup, Year 1" student recording sheet.

> As explained in *Harry Potter and the Sorcerer's Stone*, "The four houses are called Gryffindor, Hufflepuff, Ravenclaw, and Slytherin. Each house has its own noble history and each has produced outstanding witches and wizards. While you are at Hogwarts, your triumphs will earn your house points, while any rule breaking will lose house points. At the end of the year, the house with the most points is awarded the House Cup, a great honor. I hope each of you will be a credit to whichever house becomes yours."

1. A house at Hogwarts is given 10 points when a student knows the answer to an important question in class. Write an **expression** if Gryffindor earned 20 points for answering important questions during one week.
2. A house at Hogwarts is given 5 points when students show they have learned a magic spell. Write an expression if Hogwarts earned 15 points for magic spells during one week
3. At the end of one week, Harry wants to know how many points Gryffindor has earned. He sees they have earned 40 points for answering questions correctly. Write an **equation** that represents the number of points the Gryffindor students earned for answering questions correctly.
4. Professor McGonagall kept track of the number of points Gryffindor students received for correct answers and knowing magic spells one week. She wrote these two equations on the board to show the total points:

$$(10 \times 2) + (7 \times 5) = \square$$

$10 * 2 + 7 * 5 = \square$

$10(2) + 7(5) = \square$

$10 \cdot 2 + 7 \cdot 5 = \square$

How are these equations the same? How are they different?
Will the answer for these equations be the same or different? How do you know?

5. Professor McGonagall wrote an equation to show the total number of points Gryffindor earned during one week.

   $(10 \times 3) + (5 \times 4) = 50$

   If students earned 10 points for answering difficult questions correctly and 5 points for using a magic spell correctly, use words to explain the equation above.

FORMATIVE ASSESSMENT QUESTIONS

- What do you need to do first to evaluate an expression? Why?
- Is this an expression? Is this an equation? How do you know? How can you tell the difference between an expression and an equation?

DIFFERENTIATION

Extension

- "Hogwarts House Cup, Year 4" student recording sheet is meant to be an extension. It could be used in addition to or it could replace the year 3 student recording sheet. If used in place of the year 3 student recording sheet, be sure students are asked to write equations to represent some of the relationships described in the charts on the year 4 student recording sheet. Students should be told that the points earned on the year 4 student recording sheet represent information from a different year, so while the number of points earned per activity is the same as previous years, the number of occurrences will not be the same.
- The complexity of simplifying algebraic expressions can be increased through the use of multi-step word problems.

Intervention

- Provide explicit vocabulary instruction for terms introduced in this task, such as expression, equation, and substitution. Allow students to participate in vocabulary activities to ensure these terms are understood.
- Ask students to complete a graphic organizer, such as the "Hogwarts House Cup, Note-taking Sheet." This gives students a tool they can use to help write and simplify algebraic expressions when solving problems.
- **Intervention Table**

TECHNOLOGY CONNECTION

- http://www.hp-lexicon.org/hogwarts/points.htmlThis web page describes the points awarded and deducted during the years that Harry Potter attended Hogwarts.
- http://www.hp-lexicon.org/hogwarts/sorting_hat.htmlDescribes the sorting hat and provides passages from several Harry Potter books.

Name _____ Date _____

Hogwarts House Cup

Year 1

As explained in *Harry Potter and the Sorcerer's Stone*, "The four houses are called Gryffindor, Hufflepuff, Ravenclaw, and Slytherin. Each house has its own noble history and each has produced outstanding witches and wizards. While you are at Hogwarts, your triumphs will earn your house points. At the end of the year, the house with the most points is awarded the House Cup, a great honor. I hope each of you will be a credit to whichever house becomes yours."

1. A house at Hogwarts is given 10 points when a student knows the answer to an important question in class. Write an **expression** if Gryffindor earned 20 points for answering important questions during one week.

_____

2. A house at Hogwarts is given 5 points when students show they have learned a magic spell. Write an **expression** if Hogwarts earned 15 points for magic spells during one week.

_____

3. At the end of one week, Harry wants to know how many points Gryffindor has earned. He sees they have earned 40 points for answering questions correctly. Write an **equation** that represents the number of points the Gryffindor students earned for answering questions correctly.

_____

4. Professor McGonagall kept track of the number of points Gryffindor students received for correct answers and knowing magic spells one week. She wrote these equations on the board to show the total points:

$(10 \times 2) + (7 \times 5) = \square$

$10 \ast 2 + 7 \ast 5 = \square$

$10(2) + 7(5) = \square$

$10 \cdot 2 + 7 \cdot 5 = \square$

How are these equations the same? How are they different?

Will the answer for these equations be the same or different? How do you know?

6. Professor McGonagall wrote an equation to show the total number of points Gryffindor earned during one week.

$$(10 \times 3) + (5 \times 4) = 50$$

If students earned 10 points for answering difficult questions correctly and 5 points for using a magic spell correctly, use words to explain the equation above.

Practice Task: Hogwarts House Cup Part 2

Back to Task Table

Approximately 1 day

STANDARDS FOR MATHEMATICAL PRACTICE

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.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
MGSE5.OA.2 Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.

BACKGROUND KNOWLEDGE

Students have solved two step word problems using the four operations in third grade and multi-step equations in 4^{th} grade. Therefore, the understanding of order or operations within the four operations should have been mastered. At the 5^{th} grade level students are now exploring these four operations within parentheses and brackets.

COMMON MISCONCEPTIONS:

There are many ways to show multiplication symbolically. Before doing this task, teachers should review multiplication symbols such as the one shown in problem 4 on the student worksheet.

ESSENTIAL QUESTIONS

- In what kinds of real world situations might we use equations and expressions?
- How can we evaluate expressions?

MATERIALS

- "Hogwarts House Cup, Year 2" student recording sheet
- "Hogwarts House Cup, Year 3" student recording sheet
- Optional, "Hogwarts House Cup, Year 4" student recording sheet, 2 pages

GROUPING

Partner/Small Group Task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Students explore writing expressions and equations as well as simplifying expression in the context of points earned at Hogwarts. This task should be carried over several class periods as these ideas are developed

Comments

This task could be introduced by reading short passages from one of the Harry Potter books where points are given or deducted or when the students are sorted into houses. See the "Technology Connection" below for links to websites with a lot of information on these topics.

This task is broken into three parts. Each part builds on the understanding from the part before it. It is best to do the parts in order. Be sure to facilitate discussion of math reasoning, which is critical to the understanding of the algebraic concepts presented.

Students may require some additional practice with the ideas presented in each part of this task. Use formative assessment data to guide your decision regarding how much practice students need with each part of the task.

This task can be used as a learning task or an alternative would be to use the individual parts of the task as formative assessment tools to measure student understanding of algebraic concepts.

Task Directions

Students will follow the directions below from the "Hogwarts House Cup, Year 2" student recording sheet.

1. Students at Hogwarts typically earn 15 points for tackling a boggart and 20 points for identifying potions. Complete the chart as shown in the example

Hogwarts House	Number of Students Tackling a Boggart	Number of Students Identifying Potions	Expression	Equation
Example	3	2	$(15 \times 3) + (20 \times 2)$	$(15 \times 3) + (20 \times 2) = 85$
Gryffindor	4	3		
Hufflepuff	2	4		
Ravenclaw	5	1		
Slytherin	3	3		

2. Students at Hogwarts typically earn 5 points for using a magic spell correctly and 10 points for correctly answering a difficult question. In the chart below:

Complete the chart as shown in the example.

Students will follow the directions below from the "Hogwarts House Cup, Year 3" student recording sheet.

Hogwarts House	Number of Students Correctly Using a Magic Spell	Number of Students Correctly Answering a Question	Expression	Equation
Example	1	1	(5 x 1) + (10 x 1)	(5 x 1) + (10 x 1) = 15
Gryffindor			(5× 5)+ (10 × 2)	
Hufflepuff	2	3		
Ravenclaw			(5× 4)+ (10 × 1)	
Slytherin	3	0		

This time you are going to find out how many points the houses at Hogwarts lost! To find the total number of points lost, you will need to write an expression with the given value to find the total number of points each house lost.

1. Students at Hogwarts typically lose 10 points for being late to class and students lose 20 points for being out of bed at midnight. Complete the chart as shown in the example

Hogwarts House	Number of Students Late to Class	Number of Students Out of Bed at Midnight	Expression	Total Number of Points Lost
Example	3	2	(10 × 3) + (20 × 2)	70
Gryffindor	4	3		
Hufflepuff	2	2		
Ravenclaw	5	1		
Slytherin	6	3		

2. Write an equation below for the number of points each house lost according to the chart above and the number of points each house earned in Hogwarts Year 2.

Example: 85 + 15 - [(10 x 3) + (20 x 2)] = 30

Gryffindor	
Hufflepuff	
Ravenclaw	
Slytherin	

FORMATIVE ASSESSMENT QUESTIONS

- What is the first step when evaluating an expression? Why?
- Is this an expression? Is this an equation? How do you know? How can you tell the difference between an expression and an equation?
- How are the expressions the same? Different?
- What remains the same between the different houses?
- What is different between the different houses?

DIFFERENTIATION

Extension

- "Hogwarts House Cup, Year 4" student recording sheets meant to be an extension. I could be used in addition to or it could replace the year 3 student recording sheet. If used in place of the year 3 student recording sheet, be sure students are asked to write equations to represent some of the relationships described in the charts on the year 4 student recording sheet. Students should be told that the points earned on the year 4 student recording sheet represent information from a different year, so while the number of points earned per activity is the same as previous years, the number of occurrences will not be the same.
- The complexity of simplifying algebraic expressions can be increased through the use of decimals and multi-step word problems.

Intervention

- Provide explicit vocabulary instruction for terms introduced in this task, such as expression, equation, and substitution. Allow students to participate in vocabulary activities to ensure these terms are understood.
- Ask students to complete a graphic organizer, such as the "Hogwarts House Cup, Note-taking Sheet." This gives students a tool they can use to help write and simplify algebraic expressions when solving problems.
- **Intervention Table**

TECHNOLOGY CONNECTION

- http://www.hp-lexicon.org/hogwarts/points.htmlThis web page describes the points awarded and deducted during the years that Harry Potter attended Hogwarts.
- http://www.hp-lexicon.org/hogwarts/sorting_hat.htmlDescribes the sorting hat and provides passages from several Harry Potter books.

Name _____ Date _____

Hogwarts House Cup

Year 2

1. Students at Hogwarts typically earn 15 points for tackling a boggart and 20 points for identifying potions
   Complete the chart as shown in the example.

Hogwarts House	Number of Students Tackling a Boggart	Number of Students Identifying Potions	Expression	Equation
Example	3	2	(15 × 3) + (20 × 2)	(15 × 3) + (20 × 2) = 85
Gryffindor	4	3		
Hufflepuff	2	4		
Ravenclaw	5	1		
Slytherin	3	3		

2. Students at Hogwarts typically earn 5 points for using a magic spell correctly and 10 points for correctly answering a difficult question. Complete the chart as shown in the example.

Hogwarts House	Number of Students Correctly Using a Magic Spell	Number of Students Correctly Answering a Question	Expression	Equation
Example	1	1	(5 x 1) + (10 x 1)	(5 x 1) + (10 x 1) = 15
Gryffindor			(5 × 5)+ (10 × 2)	
Hufflepuff	2	3		
Ravenclaw			(5 × 4)+ (10 × 1)	
Slytherin	3	0		

Name _____ Date _____

Hogwarts House Cup

Year 3

This time you are going to find out how many points the houses at Hogwart lost! To find the total number of points lost, you will need to write an expression with the given value to find the total number of points each house lost.

1. Students at Hogwarts typically lose 10 points for being late to class and students lose 20 points for being out of bed at midnight.

Complete the chart as shown in the example.

Hogwarts House	Number of Students Late to Class	Number of Students Out of Bed at Midnight	Expression	Total Number of Points Lost
Example	3	2	(10 × 3) + (20 × 2)	70
Gryffindor	4	3		
Hufflepuff	2	2		
Ravenclaw	5	1		
Slytherin	6	3		

2. Write an equation below for the number of points each house lost according to the chart above and the number of points each house earned in Hogwarts Year 2.

Example: 85 + 15 - [(10 x 3) + (20 x 2)] = 30

Gryffindor	
Hufflepuff	
Ravenclaw	
Slytherin	

3 ACT TASK: The Beanbag Dartboard

Back to Task Table

Approximately 1 day

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them. After viewing the videos of a child playing a round of Beanbag Dartboard in Act 1, students make sense of the rules for the game "Beanbag Dartboard" and plan ways to find a variety of solutions to determine where the other two beanbags would land if the child scored a given amount of points. If needed, students will modify the process being used to find solutions.

2. Reason abstractly and quantitatively. Students will make sense of the quantities in the problem by representing scores earned in a game of "Beanbag Dartboard" using an equation or expression. As students construct the equations, they will demonstrate an understanding of the relationships between the numbers and operations being used.

4. Model with mathematics. Students will construct equations and expressions that represent the score earned in a game of "Beanbag Dartboard." Students apply their knowledge of equations and expressions to help calculate scores earned during the game.

6. Attend to precision. As equations are being written, students will write precise scenarios that explain how the score can be determined from the equation.

8. Look for and express regularity in repeated reasoning. Knowing the process for constructing one equation that yields a possible score in the game "Beanbag Dartboard" can help students construct multiple scenarios for earning points during the game. Students will use repeated calculations to determine a variety of solutions for the problem.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

MGSE5.OA.2 Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.

ESSENTIAL QUESTIONS

During Act 1, students are encouraged to suggest questions that come to mind after viewing the video. In Act 2, students will solve a problem that focuses on the following learning through inquiry:

- How can I write an expression that describes a situation or context?
- How can an expression be written with a given set value?

The essential questions above can be shared at the beginning of Act 2 to define the emphasis of the problem solving opportunity being presented.

MATERIALS

Act 1 video "The Beanbag Dartboard Round 1 Act One" https://vimeo.com/96833304
The Beanbag Dartboard photo (attached)
Beanbag Dartboard Game Rules (attached)
Act 3 video "The Beanbag Dartboard Round 1 Act Three"

GROUPING

Individual, Partners or Small Groups

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will watch a child start playing a round of the game "The Beanbag Dartboard." In the video, the student tosses two beanbags onto the dartboard and then the video stops. 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

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 CCGPS Mathematics Wiki.

During this unit, fifth grade students have evaluated expressions that contain more than one operation, as well as grouping symbols. They have learned that the importance of following the conventions of the order of operations when evaluating expressions stems from the fact that different values can be found for the expression if the conventions are not followed. Fifth graders also explain relationships between the numbers in expressions by writing expressions that describe situations in problem solving tasks. Ultimately, students should be able to look at an expression and create a situation or story that describes the numerical expression.

In Act 2, students will determine where the remaining two beanbags could land given the number of total points scored during a round of the game "The Beanbag Dartboard" after viewing the start of the game. Students will request information about the rules of the game and the total points earned during each round so that they can construct expressions that describe the scoring situation after the game is complete. This gives fifth graders a chance to develop expressions that describe a situation in a real life context. This will require students to think about the relationships between the quantities

and operations being used to construct the expression that describes the total score earned in each round.

Common Misconceptions

Students may believe that in order to find the value of an expression or equation that the operation must be performed in order from left to right. When solving an expression or an equation, students also struggle with understanding that multiplication and division are equal in importance since they are inverses. That means as an expression or equation is solved, multiplication and division is completed in the order they appear from left to right. This is also true for addition and subtraction.

Task Directions

Act 1 – Whole Group - Pose the conflict and introduce students to the scenario by showing Act I video or 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 the Act 1 video "The Beanbag Dartboard Round One Act One" to students. https://vimeo.com/96833304
- Ask students what they noticed mathematically in the picture, what they wonder about, and what questions they have about what they saw in the picture.
- Give each student a copy of the Student Recording Sheet. Have students record their questions and curiosities in the Act 1 section that asks "What questions come to your mind?" Consider doing a think-pair-share so that students have an opportunity to talk with each other before sharing questions with the whole group. Students may need to watch the video several times.
- Share and record students' questions. The teacher may need to guide students so that the questions generated are math-related.
- Share the main question that will be investigated during today's lesson. In the list below it is denoted with an asterisk. (*) Students will record the main question on their recording sheet.
- Ask students to estimate answers to the main question being investigated (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 a number line. Space is available on the recording sheet for students to record open number line with all three estimates.

Anticipated questions students may ask and wish to answer:

- What are the rules of the game?
- How do you calculate your score?
- *Where do the last two beanbags land on the dartboard?
- How many points were scored during the round?
- What is the meaning of the yellow area, the blue area and the red area?

**Main question(s) to be investigated*

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."

- Before students begin work in Act 2, explain that as they work to determine where the last two beanbags land on the dartboard, they will use their knowledge of writing expressions and equations to determine possible solutions. Have students discuss as a whole group how writing expressions or equations could help them calculate the score the student earned during round 1 of the game.
- During Act 2, students review the main question from Act 1 and decide on the facts, tools, and other information needed to answer the question. The main question for this task is "Where do the last two beanbags land on the dartboard?" 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. Students may request a picture of the dartboard used during the game, the rules of the game, including scoring rules, the total number of points earned during the round and an image of where the first two beanbags landed on the dartboard. All images are provided in this lesson.
- 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?

Additional Information for Act 2

Act 2 The Beanbag Dartboard photo (attached)
Act 2 The Beanbag Dartboard Round 1 photo with total number of point earned for Round 1(attached)
The Beanbag Dartboard Rules (attached)

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 3 – Whole Group – Share solutions and strategies.

- Students present their solutions and strategies and compare them.
- Discuss with students how to construct expressions or equations that represent the possible places the beanbags could have landed during round 1. Share expressions and equations constructed for possible solutions. There are many possible solutions that students could have created since 42 of the 44 points have yet to be earned. Here are a few (not all) possible solutions:
    - Beanbag 3 could land on the 10 triple ring earning 30 points. That leaves 12 points. Beanbag 4 could land on the 4 triple ring. The expression to represent that solution is (1x1) + (1x1) + (3x10) + (3x4). The expression could also be written as (2x1) + (3 x 14).
    - Beanbag 3 could land on the 10 triple ring earning 30 points. That leaves 12 points. Beanbag 4 could land on the 6 double ring. The expression to represent that solution is (1x1) + (1x1) + (3x10) + (2x6). The expression could also be written as (2x1) + (3x10) + (2x6).
    - Beanbag 3 could land on the 9 triple ring earning 27 points. That leaves 15 points. Beanbag 4 could land on the 5 triple ring. The equation to represent that solution is (1x1) + (1x1) + (3x9) + (3x5) = 44. The equation could also be written as (2x1) + (3 x 14) = 44.
- Reveal the solution by showing "The Beanbag Dartboard Round 1 Act Three" video. https://vimeo.com/96838337
- Discuss with students how to construct an expression or an equation that can be used to represent the situation. Share expressions and equations constructed for the situation in the video. It is possible to state the equations or expressions in a couple of ways. For example, students may write (1 x 1) + (1 x 1) + (3 x 7) + (3 x 7) or (2 x 1) + (3 x 14) as possible expressions to represent the total number of points earned.
- 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/

Students can construct the beanbag dartboard and play the game. Students can then write their score as an expression. Students can compare scores by determining their value of the expressions created.

Students could also play a round against another child and write expressions or equations that represent both students' total points earned during the round. Students can play multiple rounds and calculate their total amount of points earned during the game using expression and equations.

FORMATIVE ASSESSMENT QUESTIONS

- What models did you create?
- What organizational strategies did you use?
- How did expressions help calculate scores more efficiently?
- How can a round be described using only an expression?

DIFFERENTIATION

Extension
Students can develop scenarios for "The Beanbag Dartboard Round 2." Students can create a scenario where the student earns more points in round 2 and then an additional scenario where the student earns less points in round 2. Then, students can describe each situation using mathematical equations.

Intervention
Students can use a copy of the Beanbag Dartboard picture and two colored counters to create a model of the situation and use the model to create the expression that describes the picture.

Intervention Table

TECHNOLOGY CONNECTIONS

- http://mrnussbaum.com/orderops/ Order Ops provides students with expressions to solve in bite sized chunks. Students must pay attention to which grouping and operation must be performed according to the conventions of order of operations.

The Beanbag Dartboard

Game Rules:

1. Player 1 receives four beanbags.
2. Player 1 stands at the throw line, with their toes touching the throw line.
3. Next, Player 1 tosses each beanbag one at a time at the dartboard using an underhanded throw until all four beanbags have been tossed.
4. After all four beanbags have been tossed, the student calculates his score without removing any of the beanbags from the board.
5. After the score has been calculated, the four beanbags may be removed and passed to the next player.

Scoring Rules:

1. Any beanbag that lands in the gray "non-ringed" area earns the points listed on the outside area of that section.
2. The outside ring is known as the double ring. A beanbag that lands on the double ring earns double the number of points listed on the outside area of that section.
3. The inside ring is known as the triple ring. A beanbag that lands on the triple ring earns triple the number of points listed on the outside area of that section.
4. Any beanbag landing in the bulls eye, or very center of the circle, earns 20 points.

Act Two Photo: The Beanbag Dartboard

Act Two Photo: The Beanbag Dartboard Round 1

The child earned a total of 44 points during Round 1

Three Act Task Student Recording Sheet Name _____

ACT 1

What questions come to your mind?

Main Question: _____

What is your first estimate and why?

Record an estimate that is too low and an estimate that is too high.

On an empty number line, record all three estimates made above.

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: Expression Puzzle

Back to Task Table

Approximately 1 day

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.
6. Attend to precision.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.OA.2 Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.

BACKGROUND KNOWLEDGE

Students should have had prior experiences writing expressions in previous grade levels. In this task, students will practice matching an expression written as a numeric calculation to its written form in words. In order to do this, students will need to be able to use and apply the commutative and associative properties of addition and multiplication as well as the correct order of operations. They will also need to apply third grade standard MCC3.NF.1 by understanding that dividing by a whole number is the same as multiplying by a unit fraction with that whole number as its denominator. For example, one-half of a quantity is the same as dividing by two, and one-third of a quantity is the same as dividing by three.

COMMON MISCONCEPTIONS

- Students may choose the wrong operation because they don't fully understand the meaning of each of the four operations and the vocabulary associated with each operation. Reviewing contexts for each operation and vocabulary such as product, sum, difference, etc. before doing this activity may be helpful.
- Students may try to match the numbers in an expression to the word forms of those numbers. The puzzle has been written with distractors that use the same numbers in different operations. Therefore, students will need to carefully consider the correct operation and order when selecting the matching puzzle piece.

ESSENTIAL QUESTIONS

- How can an expression be written?

MATERIALS

- Directions and questions sheet for Expression Puzzle

- Expression Puzzle sheet (may be printed on cardstock and laminated; should be cut into 15 puzzle pieces
- Teacher answer key

GROUPING

Individual or partner task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will practice interpreting numeric expressions by matching the numeric form to its meaning written in words, without evaluating the expression.

Comments

This task will allow students to practice interpreting numeric expressions in words without evaluating them. They will practice matching verbal expressions (i.e., words) to symbolic expressions (i.e., numbers and math symbols) by completing a puzzle.

Task Directions

Students will follow the directions below from the student Directions and Questions sheet.

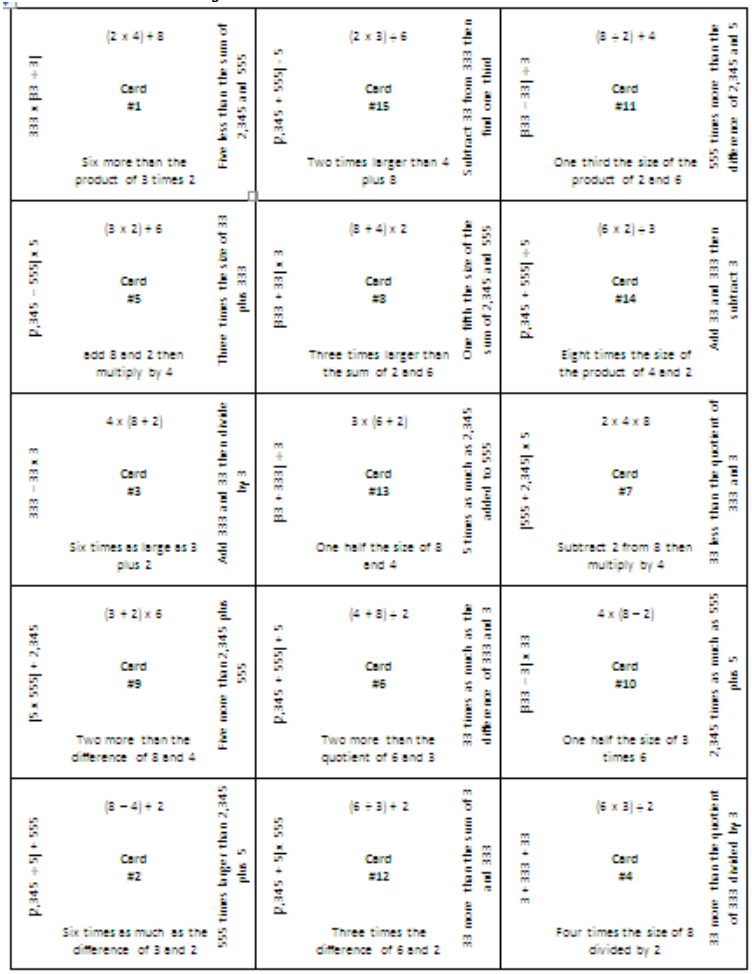
Directions:

- Complete the puzzle by matching the edge of each puzzle piece. If the edge has an expression that is written with numerically with symbols, then it should be matched to a written description of the expression. If the edge is written in words, then it needs to be matched to its symbolic representation.
- When the puzzle is completed, it will form one large rectangle.
- Some expressions do not have a match. Those expressions will be located on the outside perimeter of the puzzle.
- Be careful! Matching the correct operations and order of those operations is equally important as matching the words and numbers on the puzzle pieces. There are distractors that use the same numbers but have incorrect operations or order.
- As you decide which puzzle pieces go together, you and your partner or group members should discuss why the pieces will or will not fit together.

After completing the puzzle, answer the following questions.

1. How did you decide which cards matched?
2. What did you consider as decided why puzzle pieced did or did not fit together?
3. Give an example of when you used the commutative property. Explain how the commutative property is used in your example.
4. Give an example of when you used the associative property. Explain how the associative property is used in your example.
5. Give an example of when you had to pay attention to using the correct order of operations. Explain why this was important in your example.
6. In card #11, what operation did you use to represent one third? Explain why this operation worked.

Task Answer Key



FORMATIVE ASSESSMENT QUESTIONS

- The questions listed above on the student directions and questions sheet are the formative assessment questions for this task.

DIFFERENTIATION

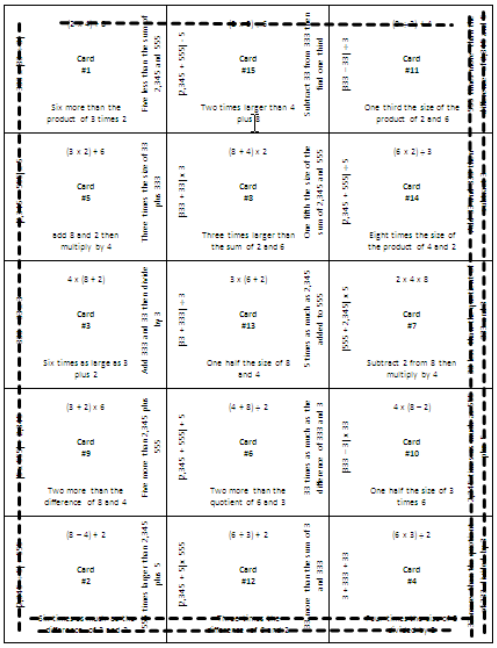
Extension

- Students can solve each expression.
- Students can determine which expressions would have the same value if the grouping symbols are removed.
- Students can create their own expression puzzle.

Intervention

- Modify puzzle to use expressions that only include operations, not parentheses.

- Tell students that puzzle card #1 is should be located in the top left-hand corner of the puzzle and that puzzle card #2 is not the next puzzle piece.
- Find sets of 2 cards that match instead of completing the entire puzzle.
- Reduce the number of puzzle pieces.
- Remove the distractors that do not have matches from the outside of the puzzle as shown below.



- **Intervention Table**

Name _____ Date _____

Expression Puzzle

Directions:

- Complete the puzzle by matching the edge of each puzzle piece. If the edge has an expression that is written with numerically with symbols, then it should be matched to a written description of the expression. If the edge is written in words, then it needs to be matched to its symbolic representation.
- When the puzzle is completed, it will form one large rectangle.
- Some expressions do not have a match. Those expressions will be located on the outside perimeter of the puzzle.
- Be careful! Matching the correct operations and order of those operations is equally important as matching the words and numbers on the puzzle pieces. There are distractors that use the same numbers but have incorrect operations or order.
- As you decide which puzzle pieces go together, you and your partner or group members should discuss why the pieces will or will not fit together.

After completing the puzzle, answer the following questions.

1. How did you decide which cards matched?

_____

_____

_____

2. What did you consider as you decided why puzzle pieces did or did not fit together?

_____

_____

_____

3. Give an example of when you used the commutative property. Explain how the commutative property is used in your example.

_____

_____

4. Give an example of when you used the associative property. Explain how the associative property is used in your example.

_____

_____

5. Give an example of when you had to pay attention to using the correct order of operations. Explain why this was important in your example.

_____

_____

6. In card #11, what operation did you use to represent one third? Explain why this operation worked.

_____

_____

Teacher note: The puzzle pieces for this task are located on this page and the next page. They should be cut out into 15 pieces before doing the puzzle. The puzzle pieces could be copied on card stock and laminated for durability and future use.

333 x (33 ÷ 3)	(2 x 4) + 8 **Card #1** Six more than the product of 3 times 2	Five less than the sum of 2,345 and 555
(2,345 + 555) - 5	(2 x 3) ÷ 6 **Card #15** Two times larger than 4 plus 8	Subtract 33 from 333 then find one third
(333 – 33) ÷ 3	(8 ÷ 2) + 4 **Card #11** One third the size of the product of 2 and 6	555 times more than the difference of 2,345 and 5
(2,345 – 555) x 5	(3 x 2) + 6 **Card #5** Add 8 and 2 then multiply by 4	Three times the size of 33 plus 333
(333 + 33) x 3	(8 + 4) x 2 **Card #8** Three times larger than the sum of 2 and 6	One fifth the size of the sum of 2,345 and 555
(2,345 + 555) ÷ 5	(6 x 2) ÷ 3 **Card #14** Eight times the size of the product of 4 and 2	Add 33 and 333 then subtract 3
333 – 33 x 3	4 x (8 + 2) **Card #3** Six times as large as 3 plus 2	Add 333 and 33 then divide by 3
(33 + 333) ÷ 3	3 x (6 + 2) **Card #13** One half the size of 8 and 4	5 times as much as 2,345 added to 555
(555 + 2,345) x 5	2 x 4 x 8 **Card #7** Subtract 2 from 8 then multiply by 4	33 less than the quotient of 333 and 3

(5 x 555) + 2,345 (3 + 2) x 6 **Card #9** Two more than the difference of 8 and 4 Five more than 2,345 plus 555	(2,345 + 555) + 5 (4 + 8) ÷ 2 **Card #6** Two more than the quotient of 6 and 3 33 times as much as the difference of 333 and 3	(333 – 3) x 33 4 x (8 – 2) **Card #10** One half the size of 3 times 6 2,345 times as much as 555 plus 5
(2,345 ÷ 5) + 555 (8 – 4) + 2 **Card #2** Six times as much as the difference of 3 and 2 555 times larger than 2,345 plus 5	(2,345 + 5) x 555 (6 ÷ 3) + 2 **Card #12** Three times the difference of 6 and 2 33 more than the sum of 3 and 333	3 + 333 + 33 (6 x 3) ÷ 2 **Card #4** Four times the size of 8 divided by 2 33 more than the quotient of 333 divided by 3

Constructing Task: Patterns R Us

Back to Task Table

Approximately 1 day

Classroom video here: https://www.georgiastandards.org/Georgia-Standards/Pages/Implement-Math-Task-Classroom-Videos/What-Does-it-Look-Like-When-you-Implement-a-Task.aspx

STANDARDS FOR MATHEMATICAL PRACTICE

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.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.NBT.1. Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

MGSE5.NBT.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

BACKGROUND KNOWLEDGE

Students should have experiences working with connecting the pattern of the number of zeros in the product when you multiply by powers of 10. Teachers should explicitly teach the concept of exponents before doing this task.

Examples:

1. $2 \times 10^3 = 2 \times (10 \times 10 \times 10) = 2 \times 1{,}000 = 2{,}000$

   Students should be told that whole numbers have decimal points at the end. However, we do not see them unless the number includes an additional decimal value. Teachers may want to use the concept of money to illustrate this point. Students should reason that the exponent above the 10 indicates how many places the digits are shifting (not just that the digit is shifting but that you are multiplying or making the number 10 times greater, three times) when you multiply by a power of 10. Since we are multiplying by a power of 10, the digit appears to shift to the right.

2. The following table may be useful:

10^4	10^3	10^2	10^1	10^0
Ten Thousands	Thousands	Hundreds	Tens	Ones

COMMON MISCONCEPTIONS:

A common misconception among students regards deriving the rules for multiplying a number by a power of 10. Many students correctly recognize that multiplying a whole number by a power of 10 will result in a product with as many 0s at the end as were in the power of 10. When students transition to multiplying decimals by powers of 10, they often generalize this "rule" without thinking about the value that results. It is important to create dialogue around this misconception, especially during the initial stages of deriving rules for multiplying and dividing numbers by powers of 10.

ESSENTIAL QUESTIONS:

- How does multiplying a whole number by a power of ten affect the product?

MATERIALS

- "Patterns-R-Us" Recording Sheet
- Calculators (one per team)

GROUPING

Partner/Small Group Task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:

In this task, students are asked to identify, describe, and explain any patterns they notice when multiplying numbers by powers of 10 such as 1,000, 100 and 10. **Students need to be provided with opportunities to explore this concept and come to this understanding; this should not just be taught procedurally**. In this unit we are only dealing with whole numbers. Decimals will be addressed in Units 2 & 3.

Comments

This task is designed to serve as a discovery opportunity for the students. Students should notice that a pattern is created when a number is multiplied by a power of 10. While students may

notice patterns in each individual part of the task, encourage them to look for a pattern when considering the overall task. Students should be able to explain and defend their solutions through multiple representations. For example, students should try several numbers for each part to verify that each number follows the same pattern. This activity lends itself to working in pairs for reinforcement.

Calculators are optional for this investigation. However, students will be more likely to explore a variety of numbers and be able to recognize patterns more efficiently with the use of a calculator. Require students to record what they put into the calculator and the result. If students could benefit from some practice with multiplication, require them to solve the problems in part one without a calculator and you can allow students to use a calculator for the rest of the task.

TASK

Students will follow the directions below from the "Patterns-R-Us" Recording Sheet.

A statistician is interested in finding out what pattern is created, if any, under certain situations. Your mission is to help come up with concrete rules for certain mathematical situations. Record all of your work and explain your thinking in order to defend your answer. Good luck!

PART ONE

1. Start with 4.
2. Multiply that number by 1000, 100, and 10.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000?

PART TWO

1. Start with 23.
2. Multiply that number by 1000, 100, and 10.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000?

PART THREE

1. Start with any whole number.
2. Multiply that number by 1000, 100, and 10.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000?

PART FOUR

1. $28 \times 10^2 = 2{,}800$
2. $28 \times 10^3 = 28{,}000$
3. What is the product of 28×10^4?
4. Is there a pattern?

5. Is there a similar pattern you've noticed?

FORMATIVE ASSESSMENT QUESTIONS

- Justify why your answer is correct.
- What would happen if you started with a different number?
- What patterns are you noticing?
- Can you predict what would come next in the pattern? Explain your prediction.

DIFFERENTIATION

Extension

- Have students extend the pattern of exponents to include 10^5 and 10^6. What numbers will be represented?

Intervention

- Pair students who may need additional time together so that they will have time needed to process this task.
- Students may need to use a 10 x 10 grid to relate back to 10^2 as having an area of 100 sq. units.
- **Intervention Table**

TECHNOLOGY CONNECTION

- http://www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks1/maths/dice/ - Virtual 6-, 8-, and 10-sided dice

Name_____ Date_____

Patterns-R-Us

A statistician is interested in finding out what pattern is created, if any, under certain situations. Your mission is to help come up with concrete rules for certain mathematical situations and operations. Record all of your work and explain your thinking so that you can defend your answers.

Multiply and put it in the box	4
X 1,000	
X 100	
X 10	

What is happening?

_____

_____

_____

Is there a pattern?

_____

_____

_____

What do you think would happen if you multiplied your number by 1,000,000?

_____

_____

_____

Multiply and put it in the box	23
X 1,000	
X 100	
X 10	

What is happening?

_____

_____

_____

Is there a pattern?

_____

_____

_____

What do you think would happen if you multiplied your number by 1,000,000?

_____

_____

_____

Pick a whole number to multiply and put it in the box	
X 10	
X 100	
X 1,000	

What is happening?

Is there a pattern?

What do you think would happen if you multiplied your number by 1,000,000?

Complete the pattern	28
X 10^2	2,800
X 10^3	28,000
X 10^4	

Is there a pattern?

Is there a similar pattern you've noticed?

Looking at the patterns you have identified, what conjecture can you make about multiplying numbers by powers of 10?

How does the use of exponents in 10^2 and 10^3 connect to changes in the place value of numbers?

Practice Task: Multiplication Three in a Row

Back to Task Table

Approximately 1 day

STANDARDS FOR MATHEMATICAL PRACTICE

6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.NBT.5 Fluently multiply multi-digit whole numbers using the standard algorithm (or other strategies demonstrating understanding of multiplication) up to a 3 digit by 2 digit factor.

BACKGROUND KNOWLEDGE

This game can be made available for students to play independently. However, it is important for students to share some of the strategies they develop as they play more. Strategies may include:

- estimating by rounding the numbers in Box A
- multiplying tens first, then ones; for example, 47 x 7 = (40 x 7) + (7 x 7) = 280 + 49 = 329

Be sure students know and understand the appropriate vocabulary used in this task. Provide index cards or sentence strips with key vocabulary words (i.e. factor, product). Have students place the cards next to the playing area to encourage the usage of correct vocabulary while playing the game.

COMMON MISCONCEPTIONS

Students may overlook the place value of digits, or forget to use zeros as place holders, resulting in an incorrect partial product and ultimately the wrong answer.

ESSENTIAL QUESTIONS

- How can estimating help us when solving multiplication problems?
- What strategies can we use to efficiently solve multiplication problems?

MATERIALS

- Color Counters
- “Three in a Row” game board (printed on card stock and/or laminated for durability)
- Calculators

GROUPING:

Small Group or Partner Task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:

In this task, students practice multiplying 2-digit by 2 or 3-digit numbers in a game format.

Comments: Being able to estimate and mentally multiply a 2-digit number by a 2 or 3-digit number is an important pre-requisite skill for dividing a whole number by a 2-digit number. Helping students develop their mental computation or estimation abilities in general is also an important focus of Grade 4 GPS. As students play this game, encourage students to try mental computation and explain strategies. It is important to remind them that they can use the calculator **only after** they announce their products. Remember that we want students to use estimation skills and mental math strategies to multiply a 2-digit number by a 2 or 3-digit number

KEY TO THREE IN A ROW GAME

79x25 *or* 25x79 **1,975**	91x76 *or* 76x91 **6,916**	232x802 *or* 802x232 **186,064**	472x32 *or* 32x472 **15,104**	91x802 *or* 802x91 **72,982**	18x512 *or* 512x18 **9,216**
18x802 *or* 802x18 **14,436**	232x32 *or* 32x232 **7,424**	472x76 *or* 76x472 **35,872**	35x512 *or* 512x35 **17,920**	232x25 *or* 25x232 **5,800**	18x97 *or* 97x18 **1,746**
91x97 *or* 97x91 **8,827**	79x512 *or* 512x79 **40,448**	18x25 *or* 25x18 **450**	232x76 *or* 76x232 **17,632**	79x32 *or* 32x79 **2,528**	35x802 *or* 802x35 **28,070**
79x76 *or* 76x79 **6,004**	472x25 *or* 25x472 **11,800**	472x97 *or* 97x472 **45,784**	35x97 *or* 97x35 **3,395**	232x512 *or* 512x232 **118,784**	91x32 *or* 32x91 **2,912**
18x32 *or* 32x18 **576**	79x97 *or* 97x79 **7,663**	472x512 *or* 512x472 **241,664**	79x802 *or* 802x79 **63,358**	18x76 *or* 76x18 **1,368**	35x25 *or* 25x35 **875**
91x512 *or* 512x91 **46,592**	472x802 *or* 802x472 **378,544**	35x32 *or* 32x35 **1,120**	91x25 *or* 25x91 **2,275**	232x97 *or* 97x232 **22,504**	35x76 *or* 76x35 **2660**

Task Directions

Students will follow the directions below from the "Three in a Row" game board.

This is a game for two or three players. You will need color counters (a different color for each player), game board, pencil, paper, and a calculator.

Step 1: Prior to your turn, choose one number from Box A and one number from Box B. Multiply these numbers on your scratch paper. Be prepared with your answer when your turn comes.

Step 2: On your turn, announce your numbers and the product of your numbers. Explain your strategy for finding the answer.

Step 3: Another player will check your answer with a calculator after you have announced your product. If your answer is correct, place your counter on the appropriate space on the board. If the answer is incorrect, you may not place your counter on the board and your turn ends.

Step 4: Your goal is to be the first one to make "three-in-a-row," horizontally, vertically, or diagonally.

FORMATIVE ASSESSMENT QUESTIONS

- Who is winning the game? How do you know?
- (To the winner) What was your strategy?
- Is there any way to predict which factors would be best to use without having to multiply them all? Explain.
- How are you using estimation to help determine which factors to use?
- How many moves do you think the shortest game of this type would be if no other player blocked your move? Why?

DIFFERENTIATION

Extension

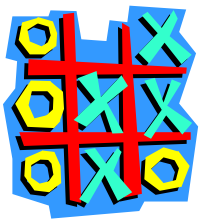
- A variation of the game above is to require each player to place a paper clip on the numbers they use to multiply. The next player may move only one paper clip either the one in Box A or the one in Box B. This limits the products that can be found and adds a layer of strategy to the game.
- Another variation is for students to play "Six in a Row" where students need to make six products in a row horizontally, vertically, or diagonally in order to win.
- Eventually, you will want to challenge your students with game boards that contain simple 3-digit numbers (e.g. numbers ending with a 0 or numbers like 301) in Box A or multiples of 10 (i.e., 10, 20, … 90) in Box B. As their competency develops, you can expect them to be able to do any 3-digit by 2-digit multiplication problem you choose.

Intervention

- Allow students time to view the game boards and work out two or three of the problems ahead of time to check their readiness for this activity.
- Use benchmark numbers in Box A, such as 25, 50, 100, etc.
- **Intervention Table**

Name _____ Date _____

Three in a Row Game Board



This is a game for two or three players. You will need color counters (a different color for each player), game board, pencil, paper, and a calculator.

Step 1: Prior to your turn, choose one number from Box A and one number from Box B. Multiply these numbers on your scratch paper. Be prepared with your answer when your turn comes.

Step 2: On your turn, announce your numbers and the product of your numbers. Explain your strategy for finding the answer.

Step 3: Another player will check your answer with a calculator after you have announced your product. If your answer is correct, place your counter on the appropriate space on the board. If the answer is incorrect, you may not place your counter on the board and your turn ends.

Step 4: Your goal is to be the first one to make "three-in-a-row," horizontally, vertically, or diagonally.

Box A						Box B					
18	232	35	472	79	91	25	32	512	76	802	97

1,975	6,916	186,064	15,104	72,982	9,216
14,436	7,424	35,872	17,920	5,800	1,746
8,827	4,0448	450	17,632	2,528	28,070
6,004	11,800	45,784	3,395	118,784	2,912
576	7,663	24,1664	63,358	1,368	875
46,592	37,8544	1,120	2,275	22,504	2,660

Career-Based Task: Preparing a Prescription

Back to Task Table

Approximately 1 day

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.
6. Attend to precision.
8. Look for and express regularity in repeated reasoning.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.NBT.5 Fluently multiply multi-digit whole numbers using the standard algorithm (or other strategies demonstrating understanding of multiplication) up to a 3 digit by 2 digit factor.

BACKGROUND KNOWLEDGE

Students should understand how to use grid paper and partial products area models to determine multiplication products with numbers larger than 10. Use this task or another one similar to it to help students make the transition from depending on manipulatives for determining products of larger numbers to being able to determine these products through self-made diagrams.

In 3rd grade students multiplied one digit numbers by multiples of 10. This concept can be applied when using the distributive property and partial products.

COMMON MISCONCEPTIONS

Students may overlook the place value of digits, or forget to use zeroes as place holders, resulting in an incorrect partial product and ultimately the wrong answer. Students may not understand the shifting of the digit changes the value of the digit. When multiplying by a power of 10 students may say they are adding a zero, when in reality they are increasing the value of the number and this causes shifting of the digit as the value of the number changes.

ESSENTIAL QUESTIONS

- What strategies can I use to multiply whole numbers?
- How can I use what I know about multiplying multiples of ten to multiply two whole numbers?

MATERIALS

- "Preparing a Prescription" supply list
- Preparing a Prescription" recording sheets

GROUPING

Individual or partner task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

In this task, students will practice and apply multiplying a one-digit number by up to a four digit number. Students will use multiplication to determine the amount of supplies to ship to a patient's home to treat an illness. Using this information, students will need to complete an invoice reflecting just enough medication for the patient's duration of treatment.

In this task, students will make diagrams to discover and demonstrate the answers to 1-digit to 4-digit or two 2-digit numbers multiplication problem.

Comments
This task provides opportunities for students to work with arrays in real world situations as they work with larger numbers. The recording sheet asks students to complete an invoice to fill a prescription.

The idea of moving beyond building arrays with base-ten blocks to drawing rectangles on paper or grid paper is critical. At this point students must begin to visualize the multiplication process without the blocks. As students begin to work, they may realize that modeling problems such as these can require a large number of base-ten blocks. Ask them to think of ways to do the same problem without having to utilize base-ten blocks.

This task has some terminology that may be hard for students. Don't discard the task take a look at the link for information that can be shared with students to ensure success with this task.
http://www.cleanvideosearch.com/media/action/yt/watch?videoId=eY0ZirfahAM
This would be a great task for college/career ready day.

TASK

Part I
A patient with Cholangitis, an infection in the ducts in the liver, must receive antibiotics through a picc line in the arm. The antibiotic, Zosyn, must be taken every 8 hours for 2 full weeks. To administer the medicine safely, the listed procedure must be followed:

1. Clean the line cap with an alcohol wipe.
2. Flush the line with 5 mL of Sodium Chloride.
3. Administer the medicine.
4. Flush the line with 2 mL of Heparin.
5. Flush the line with 5 mL of Sodium Chloride.
6. Wipe cap with an alcohol wipe.

Use the supply list to complete the invoice to fulfill a medication order for a patient with Cholangitis.

Ambient Healthcare of Georgia
800 Medical Drive
Marietta, GA 30067-8942
770-555-3393
Invoice for patient Samora Sexton

Category	Delivery Item	Quantity
Compounded Drugs		
Rx#: 50031341	Heparin Flush 100 units of 5mL pre-filled syringes	*42*
Rx#: 50031342	Sodium Chloride Flush 5 mL pre-filled syringes	*84*
Rx#: 50031340	Zosyn 520 mg in 52 mL accuflo pump	*42*
Supplies		
	Alcohol wipes box of 100	*1 box*

Part II

A patient with Cholangitis, an infection in the ducts in the liver, must receive antibiotics through a picc line in the arm. The antibiotic, Zosyn, must be taken every 8 hours for 2 full weeks. To administer the medicine safely, the listed procedure must be followed:

1. Clean the line cap with an alcohol wipe.
2. Flush the line with 5 mL of Sodium Chloride.
3. Administer the medicine.
4. Flush the line with 2 mL of Heparin.
5. Flush the line with 5 mL of Sodium Chloride.
6. Wipe cap with an alcohol wipe.

Use the supply list to complete the invoice to fulfill a medication order for 12 patients with Cholangitis.

Ambient Healthcare of Georgia
800 Medical Drive
Marietta, GA 30067-8942
770-555-3393

Invoice for patient Samora Sexton

Category	Delivery Item	Quantity
Compounded Drugs		
Rx#: 50031341	Heparin Flush 100 units of 5mL pre-filled syringes	*504*
Rx#: 50031342	Sodium Chloride Flush 5 mL pre-filled syringes	*1008*
Rx#: 50031340	Zosyn 520 mg in 52 mL accuflo pump	*504*
Supplies		
	Alcohol wipes box of 100	*2 box*

FORMATIVE ASSESSMENT QUESTIONS

- How can you model the multiplication involved in this task?
- What multiplication strategies will you use to determine the product?
- How is your model related to the multiplication strategies that you used?
- How did you determine the number of each item needed for the duration of the treatment?

DIFFERENTIATION

Extension

- You need to pull all supplies from the warehouse for fill all orders for this week. If you have to fill 20 identical orders, how much Heparin, Sodium Chloride, alcohol wipes and Zosyn do you need to pull from the warehouse?

Intervention

- Have students complete the invoice for one week instead of two weeks.
- **Intervention Table**

Name _____ Date _____

Preparing a Prescription

A patient with Cholangitis, an infection in the ducts in the liver, must receive antibiotics through a picc line in the arm. The antibiotic, Zosyn, must be taken every 8 hours for 2 full weeks. To administer the medicine safely the listed procedure must be followed:

1. Clean the line cap with an alcohol wipe.
2. Flush the line with 5 mL of Sodium Chloride.
3. Administer the medicine
4. Flush the line with 2 mL of Heparin
5. Flush the line with 5 mL of Sodium Chloride
6. Wipe cap with an alcohol wipe

Use the supply list to complete the invoice to fulfill a medication order for a patient with Cholangitis.

Warehouse Supply List

Rx#: 50031341	Heparin Flush 100 units of 5mL pre-filled syringes
Rx#: 50031342	Sodium Chloride Flush 5 mL pre-filled syringes
Rx#: 50031340	Zosyn 520 mg in 52 mL accuflo pump
	Skin prep pads
	Statlock CV Pediatric Pad
	Uni-Solve Adhesive Wipes
	Alcohol wipes box of 100

Name _____ Date _____

Part I

Ambient Healthcare of Georgia
800 Medical Drive
Marietta, GA 30067-8942
770-555-3393
Invoice for patient Samora Sexton

Category	Delivery Item	Quantity
Compounded Drugs		
Rx#: 50031341	Heparin Flush 100 units of 5mL pre-filled syringes	
Rx#: 50031342	Sodium Chloride Flush 5 mL pre-filled syringes	
Rx#: 50031340	Zosyn 520 mg in 52 mL accuflo pump	
Supplies		
	Alcohol wipes box of 100	

Part II

Preparing a Prescription

A patient with Cholangitis, an infection in the ducts in the liver, must receive antibiotics through a picc line in the arm. The antibiotic, Zosyn, must be taken every 8 hours for 2 full weeks. To administer the medicine safely the listed procedure must be followed:

1. Clean the line cap with an alcohol wipe.
2. Flush the line with 5 mL of Sodium Chloride.
3. Administer the medicine
4. Flush the line with 2 mL of Heparin
5. Flush the line with 5 mL of Sodium Chloride
6. Wipe cap with an alcohol wipe

Use the supply list to complete the invoice to fulfill a medication order for 12 patients with Cholangitis.

Ambient Healthcare of Georgia
800 Medical Drive
Marietta, GA 30067-8942
770-555-3393
Invoice for 12 patients

Category	Delivery Item	Quantity
Compounded Drugs		
Rx#: 50031341	Heparin Flush 100 units of 5mL pre-filled syringes	
Rx#: 50031342	Sodium Chloride Flush 5 mL pre-filled syringes	
Rx#: 50031340	Zosyn 520 mg in 52 mL accuflo pump	
Supplies		
	Alcohol wipes box of 100	

Division and Interpreting Remainders (FAL)

Formative Assessments Lessons (FALs)

Back to Task Table

What is a Formative Assessment Lesson (FAL)? The Formative Assessment Lesson is designed to be part of an instructional unit typically implemented approximately two-thirds of the way through the instructional unit. The results of the tasks should then be used to **inform** the instruction that will take place for the remainder of the unit. Formative Assessment Lessons are intended to support teachers in formative assessment. They 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. They assess students' understanding of important concepts and problem solving performance, and help teachers and their students to work effectively together to move each student's mathematical reasoning forward.

What does a Formative Assessment Lesson look like in action? Videos of Georgia Teachers implementing FALs can be accessed HERE and a sample of a FAL lesson may be seen HERE

Where can I find more information on FALs? More information on types of Formative Assessment Lessons, their use, and their implementation may be found on the Math Assessment Project's guide for teachers.

Where can I find samples of FALs?
Formative Assessment Lessons can also be found at the following sites:
Mathematics Assessment Project
Kenton County Math Design Collaborative
MARS Tasks by grade level

A **sample FAL** with extensive dialog and suggestions for teachers may be found HERE. This resource will help teachers understand the flow and purpose of a FAL.

Where can I find more training on the use of FALs? The Math Assessment Project has developed Professional Development Modules that are designed to help teachers with the practical and pedagogical challenges presented by these lessons.

Module 1 introduces the model of *formative assessment* used in the lessons, its theoretical background and practical implementation. Modules 2 & 3 look at the two types of *Classroom Challenges* in detail. Modules 4 & 5 explore two crucial pedagogical features of the lessons: asking probing questions and collaborative learning.

All of our Georgia RESAs have had a math specialist trained to provide instruction on the use of formative assessment lessons in the classroom. The request for training should be made through the teacher's local RESA and can be referenced by asking for more information on the Mathematics Design Collaborative (MDC).
Also, if done properly, these lessons should take about 120-150 minutes, 2-3 classroom periods.
Sources of Information: Vicki Mixon, Former MDC (Math Design Collaborative) trainer, http://www.reneeyates2math.com/ and from The Mathematics Assessment Project and http://melissatabor.wikispaces.com/Formative+Assessment+Lessons+%28FALs%29 Division and Interpreting Remainders (FAL)

Constructing Task: The Grass is Always Greener

Approximately1 day Back to Task Table

Classroom video here: https://www.georgiastandards.org/Georgia-Standards/Pages/Implement-Math-Task-Classroom-Videos/What-Does-it-Look-Like-When-you-Implement-a-Task.aspx

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
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.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.NBT.5 Fluently multiply multi-digit whole numbers using the standard algorithm (or other strategies demonstrating understanding of multiplication) up to a 3 digit by 2 digit factor.
MGSE5.NBT.6. Fluently divide up to 4-digit dividends and 2-digit divisors by using at least one of the following methods: strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations or concrete models. (e.g., rectangular arrays, area models)

BACKGROUND KNOWLEDGE

Along with the use of multiplication and division of whole numbers, students need to compute the area of each roll of sod and the area of the football field. Students will need to recognize that all units of measure are the same unit. Students may find it helpful to use ratio tables or two-column charts to find the cost for the same amount of sod.

COMMON MISCONCEPTIONS

Students may confuse area and perimeter and feet and square feet. Students may think that prices may be used for comparison rather than considering size.

ESSENTIAL QUESTIONS

- How can I apply my understanding of area of a rectangle and square to determine the best buy for a football field?
- How can we compare the cost of materials?

MATERIALS

- Paper/Graph paper
- Pencil
- Accessible manipulatives

GROUPING

Small Group/Individual Task

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

This is a challenging task that may be visited later in the year. Students will solve a real world task, deciding which turf is the better buy

Comments
To get students started, the area of a rectangle should be reviewed. Students can work in groups of three for about 15 minutes to brainstorm ideas on how to approach the problem, and then separated to do individual work.

TASK

The Westend Recreation Center Booster Club is considering replacing the existing grass football field with a new type that is softer that provides better traction. Visiting teams have been complaining about the large number of injuries from inadvertent slips on the slippery sod. Local fans have agreed to volunteer labor and equipment. The Booster Club is concerned only with the cost of the sod for the field. They are looking for the best buy for their money.

Below are price quotes from various local nurseries:

6' x 2' roll $1.00
6' x 6' roll $4.00
8' x 3' roll $2.00
6' x 3' roll $3.00

The field dimensions are 240ft x 360ft.

Which is the best buy?
How many rolls of sod will be needed?
What will be the total cost of the sod?

FORMATIVE ASSESSMENT QUESTIONS

- How can you determine the total size of the football field?
- How can you determine the cost of each roll of sod?
- How can you determine the cost of different sized pieces of sod?
- How can you organize your thinking to help you solve this problem?
- Which size roll is the best buy and why?

DIFFERENTIATION

Extension

- Make a scale diagram of how the sod will be laid down on the field.

Intervention

- The Westend Recreation Center Booster Club is considering replacing the existing grass football field with a new type that is softer. Local fans have agreed to volunteer labor and equipment. The Booster Club is concerned only with the cost of the sod for the field. They found that a 6' x 2' roll costs $2.00. The field dimensions are 240' x 360'. How many rolls of sod will be needed? What will be the total cost of the sod?
- **Intervention Table**

TECHNOLOGY CONNECTION

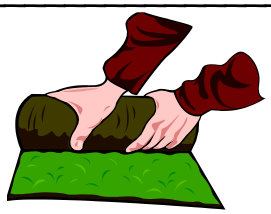
http://www.syvum.com/math/wordproblems/level1.html A resource for teachers to find additional word problems

http://www.mathplayground.com/tb_multiplication/thinking_blocks_multiplication_division.html Word problems and interactive bar models for making sense of multiplication and division

*https://www.conceptuamath.com/app/tool/open-array-division Interactive tool for modeling partial quotients division algorithm with an open array

Name _____ Date _____

The Grass is Always Greener



The Westend Recreation Center Booster Club is considering replacing the existing grass football field with a new type that is softer that provides better traction. Visiting teams have been complaining about the large number of injuries from inadvertent slips on the slippery sod. Local fans have agreed to volunteer labor and equipment. The Booster Club is concerned only with the cost of the sod for the field. They are looking for the best buy for their money.

Below are price quotes from various local nurseries:

6' x 2' roll $1.00
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8' x 3' roll $2.00
6' x 3' roll $3.00

The field dimensions are 240ft x 360ft.

Which is the best buy?

How many rolls of sod will be needed?

What will be the total cost of the sod?

<u>Practice Task:</u> Division Four in a Row

Approximately 1 day

Back to Task Table

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
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.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.NBT.6. Fluently divide up to 4-digit dividends and 2-digit divisors by using at least one of the following methods: strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations or concrete models. (e.g., rectangular arrays, area models)

BACKGROUND KNOWLEDGE

Be sure students know and understand the appropriate vocabulary used in this task. Provide index cards or sentence strips with key vocabulary words (i.e. quotient, dividend, and divisor). Have students place the cards next to the playing area to encourage the usage of correct vocabulary while playing the game.

As students play this game, it is important to remind them that they can use the calculator **only after** they announce their quotients. Remember that we want students to use estimation skills and mental math strategies to divide.

Even though this standard leads more towards computation, the connection to story contexts is critical. In Number Talks, you may want to reinforce the strategy of halving the dividend and divisor to increase mental computation skills. In fourth grade, students' experiences with division were limited to dividing by one-digit divisors. This standard extends students' prior experiences with strategies, illustrations, and explanations. When the two-digit divisor is a "familiar" number, a student might decompose the dividend using place value.

COMMON MISCONCEPTIONS

Students may be confused between the divisor and the dividend. With estimation, students may disregard place value.

ESSENTIAL QUESTIONS

- How can estimating help us when solving division problems?
- What strategies can we use to efficiently solve division problems?

MATERIALS

- Color Counters
- "Division Four in a Row" game board (printed on card stock and/or laminated for durability)
- Calculators

GROUPING

Small Group or Partner Task

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:

In this task, students practice dividing numbers up to 4-digits by 1 and 2-digit numbers in a game format.

Comments

Being able to estimate and mentally divide a 3 and 4-digit number by a 1-digit number is an important pre-requisite skill for dividing a whole number by a 2-digit number. Helping students develop their mental computation or estimation ability in general is also an important focus of Grade 5 MCC. This task challenges your students with game boards that contain simple 4-digit numbers in the Dividend Box or multiples of 10 (i.e., 10, 20, … 90) in the Divisor Box.

KEY TO DIVISION FOUR IN A ROW GAME

360÷10 36	8640÷12 720	2040÷24 85	8640÷6 1440	3360÷10 336	3360÷12 280
1320÷15 88	2040÷10 204	720÷6 120	360÷24 15	1320÷30 44	3360÷6 560
360÷12 30	8640÷10 864	1320÷10 132	3360÷24 140	360÷6 60	2040÷30 68
1320÷12 110	2040÷15 136	360÷15 720÷30 24	3360÷15 224	360÷30 12	3360÷30 112
2040÷12 170	360÷15 720÷30 24	1320÷6 220	1320÷24 55	720÷24 30	8640÷30 288
8640÷24 360	2040÷6 340	720÷15 48	8640÷15 576	720÷12 60	720÷10 72

This game can be made available for students to play independently. However, it is important for students to share some of the strategies they develop as they play. Strategies may include:

- Estimating the product of the number in a desired space with one of the divisors to find the dividend.
- Estimating by rounding the numbers in Box A.

- Using expanded notation for example, 2682 ÷ 25 = (2000 + 600 + 80 + 2) ÷ 25
- Using an equation that relates division to multiplication.
- Using base ten models to make an array.
- An area model for division and keep track of how much of the dividend is left to divide.

TASK:

Students will follow the directions below from the "Division Four in a Row" Game Board. This is a game for two or three players. You will need color counters (a different color for each player), game board, pencil, paper, and a calculator.

Step 1: Prior to your turn, choose one number from Box A and one number from Box B. Divide these numbers using a mental strategy. Record your answer on a scratch piece of paper. Be prepared with your answer when your turn comes.

Step 2: On your turn, announce your numbers and the quotient for your numbers. Explain your strategy for finding the answer.

Step 3: Another player will check your answer with a calculator after you have announced your quotient. If your answer is correct, place your counter on the appropriate space on the board. If the answer is incorrect, you may not place your counter on the board and your turn ends.

Step 4: Your goal is to be the first one to make "four-in-a-row," horizontally, vertically, or diagonally.

FORMATIVE ASSESSMENT QUESTIONS

- What do you think about what _____ said?
- Do you agree? Why or why not?
- Does anyone have the same answer but a different way to explain it? Explain.
- How can you convince the rest of us that your answer makes sense?
- Explain to us what _____ is doing?
- What strategy do you use when you have a 2-digit divisor?
- How is 3,360 divided by 6 related to 3,360 divided by 12? 24 and 12?

DIFFERENTIATION

Extension

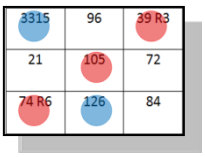
- Have students develop their own game boards to include different divisors, dividends and quotients.
- A variation of the game above is to require each player to place a paper clip on the numbers they use to divide. The next player may move only one paper clip either the one in Box A or the one in Box B. This limits the quotients that can be found and adds a layer of strategy to the game.

Intervention

- Allow students time to view the game boards and work out two or three of the problems ahead of time to check their readiness for this activity.
- Use numbers in boxes A & B that are smaller and/or change the directions to 3 in a row.
- **Intervention Table**

Technology Connection

- *http://www.dreambox.com/teachertools (scroll down to **"Division within 10,000 with Remainders**") With this Dreambox tool, students pack gumballs into bags by choosing friendly equations (partial quotients) and using the distributive property to solve multi-digit division problems within 10,000 and interpret remainders.
- *http://gregtangmath.com/includes/materials/downloads/worksheets/Division.Partials.pdf Extra practice with decomposing dividends into "friendly" numbers and finding partial quotients.
- *https://www.conceptuamath.com/app/tool/open-array-division Interactive tool for modeling partial quotients division algorithm with an open array



Name _____ Date _____

Division Four in a Row Game Board

This is a game for two or three players. You will need color counters (a different color for each player), game board, pencil, paper, and a calculator.

Step 1: Prior to your turn, choose one number from Box A and one number from Box B. Divide these numbers using a mental strategy. Record your answer on a scratch piece of paper. Be prepared with your answer when your turn comes.

Step 2: On your turn, announce your numbers and the quotient for your numbers. Explain your strategy for finding the answer.

Step 3: Another player will check your answer with a calculator after you have announced your quotient. If your answer is correct, place your counter on the appropriate space on the board. If the answer is incorrect, you may not place your counter on the board and your turn ends.

Step 4: Your goal is to be the first one to make "four-in-a-row," horizontally, vertically, or diagonally.

Dividend – Box A						**Divisor – Box B**					
3,360	**2,040**	**360**	**8,640**	**1,320**	**720**	**6**	**10**	**30**	**12**	**15**	**24**

36	720	85	1440	336	280
88	204	120	15	44	560
30	864	132	140	60	68
110	136	24	224	12	112
170	24	220	55	30	288
360	340	48	576	60	72

Constructing Task: Are These All 364 ÷ 15?

Back to Task Table

Approximately 1 day

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.
8. Look for and express regularity in repeated reasoning.

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.NBT.6. Fluently divide up to 4-digit dividends and 2-digit divisors by using at least one of the following methods: strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations or concrete models. (e.g., rectangular arrays, area models).

BACKGROUND KNOWLEDGE

Since third grade, students have worked with division through the use of partitioning whole numbers, rectangular arrays area models and through the relationship of multiplication. They should be able to apply these understandings of various division situations within this task.

This standard references various strategies for division. Division problems can include remainders. Even though this standard leads more towards computation, the connection to story contexts is critical. Make sure students are exposed to problems where the divisor is the number of groups and where the divisor is the size of the groups. In fourth grade, students' experiences with division were limited to dividing by one-digit divisors. This standard extends students' prior experiences with strategies, illustrations, and explanations. When the two-digit divisor is a "familiar" number, a student might decompose the dividend using place value.

COMMON MISCONCEPTIONS

Students may not recognize the operation in a story problem situations. Students may translate a division problem to a story problem that requires a different operation.

ESSENTIAL QUESTIONS:

- How can I use the situation in a story problem to determine the best operation to use?
- How can I effectively explain my mathematical thinking and reasoning to others?

MATERIALS

- Paper
- Pencil
- Accessible manipulatives

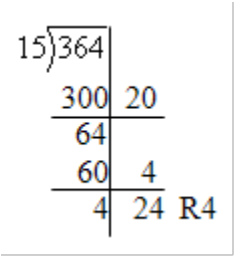
GROUPING

Individual/partner task

TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION

In this task, students analyze story problems that demonstrate three different division situations.
Comments
The three problems in this task represent situations where division can be used to solve different kinds of problems.

Problem A (measurement), creates a situation in which a given area must be divided to determine the number of openings in the fencing. This situation promotes the strategy similar to the one listed below:



Problem B calls for the partitioning of the money given by Old Mother Hubbard to her 15 children

In Problem C, subtraction is used as a strategy to divide the given amounts. This is a low level strategy, but it opportunity for students to connect their understanding of repeated subtraction to help develop a more efficient division strategy.

Notice that students were not asked to actually solve any of these situations. The teacher may have students solve them either pictorially or using student invented strategies. Regardless, students should be required to explain their thinking.

TASK

Students will follow the directions below from the "Are These All 364 ÷ 15?" recording sheet.

You have been learning about many situations that can be solved with division. Even though the following problems all use the same numbers, think about whether each describes a different type of division problem. After each problem explain why 364 ÷ 15 can or cannot be used to solve the problem.

Problem A

The new playground equipment was delivered to Anywhere Elementary School before the new fence was installed. Thomas Fencing Company arrived the next day with 364ft of fencing the school's principal wanted an opening in the fence every 25 feet. According to the principal's estimation the playground area would have about 15 openings. The Thomas Fencing Company workers estimated 20 openings around the playground. Who is correct? How do you know?

Problem B

Old Mother Hubbard found an old silver coin in her empty cupboard. She took it to the neighborhood coin collector and received $364 for the coin. With this increase in income, Old Mother Hubbard was able to pay her children for the chores they completed during the month. The 15 children inquired of their mother the amount of money each would receive. She was excited by the children's inquiry and ran to the cupboard to retrieve beans to represent the money and Ziploc bags. Her kids were told to use the materials to figure out the answer to their own question! What do you think they figured out and why?

Problem C

The new poetry book by Mel Goldstein is 364 pages packed of humorous poems. Lily Reader set a goal to read the entire book in 25 days. She planned to read 15 pages a days. With this plan, will she reach her goal? How do you know?

On the back of this paper, write 3 of your own problems that can be solved using 252 ÷ 12.

FORMATIVE ASSESSMENT QUESTIONS

- How do you know which operation to use to solve the problem?
- What is happening to the whole or dividend within this situation?
- How many total parts does this situation involve?
- Does that amount make sense in this situation? Why or why not?
- How does this situation relate to multiplication?

DIFFERENTIATION

Extension

- Students should be challenged to write problem situations that require a variety of operations and then solve them. Next, students can trade problems with a partner and discuss their solutions.

Intervention

- Carefully screen the vocabulary to make sure that it is suitable for your students.
- Working in cooperative learning groups will support the student who is an English language learner or for whom this task is challenging.
- **Intervention Table**

TECHNOLOGY CONNECTION

http://www.syvum.com/math/wordproblems/level1.html A resource for teachers to find additional word problems

*https://www.conceptuamath.com/app/tool/open-array-division Interactive tool for modeling partial quotients division algorithm with an open array

Name _____ Date _____

Are These All 364 ÷ 15?

You have been learning about many situations that can be solved with division. Even though the following problems all use the same numbers, think about whether each describes a different type of division problem. After each problem explain why 364 ÷ 15 can or cannot be used to solve the problem.

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_____

_____

_____

Problem B

Old Mother Hubbard found an old silver coin in her empty cupboard. She took it to the neighborhood coin collector and received $364 for the coin. With this increase in income, Old Mother Hubbard was able to pay her children for the chores they completed during the month. The 15 children inquired of their mother the amount of money each would receive. She was excited by the children's inquiry and ran to the cupboard to retrieve beans to represent the money and Ziploc bags. Her kids were told to use the materials to figure out the answer to their own question! What do you think they figured out and why?

_____

_____

_____

Problem C

The new poetry book by Mel Goldstein is 364 pages packed of humorous poems. Lily Reader set a goal to read the entire book in 25 days. She planned to read 15 pages a days. With this plan, will she reach her goal? How do you know?

Write 3 of your own problems that can be solved using 252 ÷ 12.

1.

2.

3.

Culminating Task: Start of the Year Celebration!

Back to Task Table

Approximately 1 day

STANDARDS FOR MATHEMATICAL PRACTICE

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

STANDARDS FOR MATHEMATICAL CONTENT

MGSE5.OA.1 Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

MGSE5.OA.2 Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them.

MGSE5.NBT.5 Fluently multiply multi-digit whole numbers using the standard algorithm (or other strategies demonstrating understanding of multiplication) up to a 3 digit by 2 digit factor.

MGSE5.NBT.6 Fluently divide up to 4-digit dividends and 2-digit divisors by using at least one of the following methods: strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations or concrete models. (e.g., rectangular arrays, area models)

BACKGROUND KNOWLEDGE

Within this unit, students were required to write and evaluate expressions using order of operations and multiply and divide multi-digit numbers. They will apply their understanding within this culminating task.

COMMON MISCONCEPTIONS

This is a culminating task that incorporates all standards for the unit. Students may still struggle with misconceptions listed in unit tasks.

ESSENTIAL QUESTIONS

- How can identifying patterns help determine multiple solutions?
- How can you determine the most cost efficient arrangement?

MATERIALS

- "Start of the Year Celebration!" student recording sheet

- Square tiles or small paper squares or toothpicks

GROUPING

Individual

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:

Students will create expressions to determine how many tables and chairs will be needed at the party.

Comments
One way to introduce this task is by reading *Spaghetti And Meatballs For All! A Mathematical Story*, by Marilyn Burns (or a similar story). The characters in the story have a similar problem; however, the number of tables in the story is fixed, while the number tables in this problem will be flexible. Use the story to initiate a conversation about various arrangements needed to seat the people invited to the party using the amount of money you have received to rent the tables.

An important part of this activity is to encourage students to find all solutions to this problem and to describe how they know they found all of the solutions. Representing solutions in a variety of ways also shows how patterns can occur numerically and geometrically, and how patterns can be written as expressions.

Students will need to understand that there must be enough room for 120 people to sit around the tables. There's a predetermined amount of money students will have to spend on tables and chairs, each costing $14 and $12 respectively. Once students determine all possible solutions, they will then decide which solution best fits the predetermined amount of $1700.

Square tiles can be used to concretely represent the tables. The shape of the table is left open to the students. Therefore, students will need to be aware two squares will represent a rectangular table.

TASK

Students will follow the directions below from the "Start of the Year Celebration!" student recording sheet.

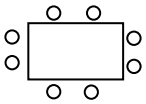
Part A:

Five fifth grade classes are planning a start of the year celebration. There are a total of 120 students invited to the celebration. The teachers have decided to rent chairs and tables from a company which charges $14 per table and $12 per chair. Write an expression for **all** the ways you could arrange the tables to seat 120 people. Use pictures and charts for your solution. Find the largest number of tables that could be used as well as the smallest number of tables that could be used to seat 120 people.

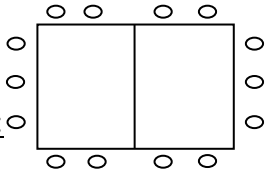
Part B:

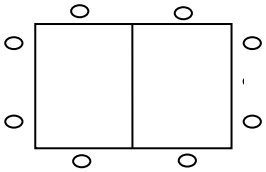
If the teachers only have $1700 to spend on the rentals, which solution would be the most cost efficient?

Possible solutions:

This arrangement 15 times: 

(120*12)+(15*14)=1650
1700-[(120*12)+(15*14)]=$50
120 chairs= $1440, 15 tables=$210, total= $1650

This arrangement 9 times: 



This arrangement once in addition:
(120*12)+(20*14)=1720
1700-[(120*12)+(20*14)]=-$20
120 chairs=$1440, 20 tables= $280, total= $1720

FORMATIVE ASSESSMENT QUESTIONS

- What shape tables would you choose to seat your guests? Explain your reasoning.
- How can you determine the cost of your representation?
- How does your representation help you to find the best possible solution?
- How much of your money will be used?

DIFFERENTIATION:

Extension

- For an extension of this activity, change to number of persons so that students can analyze the patterns using a different number of guests.

Intervention

- Arrange the tables to seat 48 people, rather than 120. Help students begin the task using an organizational strategy such as is described in the "Background Knowledge" section above.
- Work with a small group or partner.
- Model an easier problem with tables, chair, and students.
- Discuss finding factors and organizing thinking.
- **Intervention Table**

Name _____ Date _____

Start of the Year Celebration!

Part A:
Five fifth grade classes are planning start of the year celebration. There are a total of 120 students invited to the celebration. The teachers have decided to rent chairs and tables from a company which charges $14 per table and $12 per chair. Write an expression for **all** the ways you could arrange the tables to seat 120 people. Use pictures and charts for your solution. Find the largest number of tables that could be used as well as the smallest number of tables that could be used to seat 120 people.

Part B:
If the teachers only have $1700 to spend on the rentals, which solution would be the most cost efficient?