Alaska Mathematics Standards
Math Tasks Grade 5

Money For Chores

Content Standard

- **5.OA.1.** Use parentheses to construct numerical expressions, and evaluate numerical expressions with these symbols.

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description

Students work to write expressions and solve equations

Materials:

- "Money from Chores" student recording sheet

****Please visit link below for student recording sheet (pg. 25):**
MathTasks-Grade5-Unit1

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.

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?

<u>Number Talk:</u>
Number Tricks:
Have students mentally do the following sequence of operations:

- Think of any number between 1 and 20.
- 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 check 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.

After you have worked through this as a class open up for a class discussion and ask students to explain their thinking.

Background Knowledge/Common Misconceptions:

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.

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.

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.

Vocabulary:

Expression
Strategy
Solution

Expression Puzzle

Content Standard	Mathematical Practices
5.OA.2. Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 x (8 + 7). Recognizing that 3 x (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product..*	**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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets. 5. Use appropriate tools strategically. **6. Attend to precision.** 7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting 8. Look for and express regularity in repeated reasoning.

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

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

****Please visit link below for expression puzzle sheet questions and directions, puzzle pieces and teacher answer key (starting on pg.49):**
[MathTasks-Grade5-Unit1]

Comments:
This task will allow students to practice interpreting numeric expressions in words without evaluating them. They will practice matching expressions written in words to the expressions written symbolically 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.

<u>Number Talk:</u>
Strategy: Multiplying Up
Similar to the Adding Up strategy for subtraction, the Multiplying Up strategy provides access to division by building on the student's strength in multiplication. Students realize that they can also multiply up to reach the dividend. This is a natural progression as they become more confident in their use and understanding of multiplication and its relationship to division. Initially, students may rely on using smaller factors and multiples, which will result in more steps. This can provide an opportunity for discussions related to choosing efficient factors with which to multiply.

384÷16
10 x 16 = 160
10 x 16 = 160
2 x 16 = 32
2 x 16 = 32
10 + 10 + 2 + 2 = 24
24 x 16 = 384

This strategy allows students to build on multiplication problems that are comfortable and easy to use such as multiplying by tens and twos.

The open array can be used to model the student's strategy and link the operations of multiplication and division.

	10	10	2	2
16	16 x 10 =160	16 x 10 =160	16 x 2 =32	16 x 2 =32

Below are two *Multiplying Up Number Talks* for you to try with your students.

6 x 10	3 x 10
6 x 5	3 x 20
6 x 6	3 x 3
6 x 2	3 x 2
99/6	68/3

For additional Number Talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:

Students should have had prior experiences writing expressions. 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.

- 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.

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.

Vocabulary:
Expression
Operation
Commutative Property
Associative Property

Resources:
Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Multiplication Three in a Row

Content Standard

5.NBT.5. Fluently multiply multi-digit whole numbers using a standard algorithm..

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. **Attend to precision.**
7. **Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting**
8. **Look for and express regularity in repeated reasoning.**

Task Description

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

Materials:

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

****Please visit link below for game board (pg. 63):**
MathTasks-Grade5-Unit1

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**

Key to three in a row game pg. 61

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.

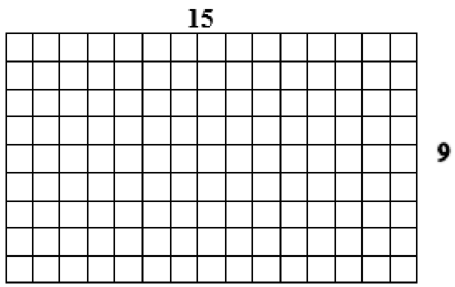
Number Talk:

Strategy: Making Landmark or Friendly Numbers

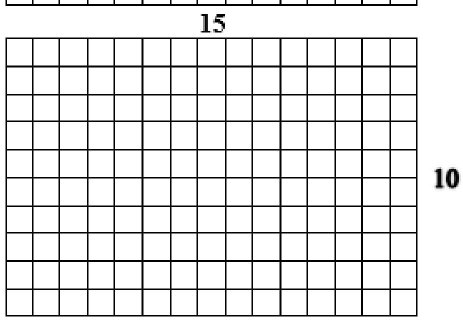
Often multiplication problems can be made easier by changing one of the factors to a friendly or landmark number. Students who are comfortable multiplying by multiples of ten will often adjust factors to allow them to take advantage of this strength.

9 x 15
<u>+ 1</u> (group of 15)
10 x 15 = 150
150 – 15 = 135

With this strategy, notice that not just one, but one group of 15 was added. This is a very important distinction for students and one that comes as they develop multiplicative reasoning.
Since one extra group of 15 was added, it now must be subtracted.



The initial problem was 9 X 15, but it was changed to 10 X 15, which resulted in an area of 150 squares.



The extra group of 15 is subtracted from the total area to represent the product for 9 X 15.

Below are two Making Landmark or Friendly Numbers, Number Talks for you to try with your students.

2×25	5×5
$4 + 25$	5×10
6×25	5×30
	5×29

For additional number talks using this strategy, please visit Number Talks by Sherry Parrish

Background Knowledge/Common Misconceptions:

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. 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.

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.

Vocabulary:

Strategy	Factors	Estimate/estimation
Horizontal	Vertical	Diagonal

References:

Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

High Roller

Content Standard	Mathematical Practices
• **5.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. • **5.NBT.3.** Read, write, and compare decimals to thousandths. a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form [e.g., 347.392 = 3 x 100 + 4 x 10 + 7 x 1 + 3 (1/10) + 9 (1/100) + 2 (1/1000)]. **b.** Compare two decimals to thousandths place based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.	**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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting** **8. Look for and express regularity in repeated reasoning.**

Task Description
In this task students will play games using place value charts to create the largest possible number by rolling a die and recording digits on the chart one at a time.

Materials:

- "High Roller" Recording Sheet for each player; choose Version 1, Version 2, or Version 3 (Smallest Difference)
- One die (6-sided, 8-sided, or 10-sided); or a deck of number cards (4 sets of 0-9)

****Please visit link below for all recording sheets (version 1, version 2, and version 3) (pg. 44):**
MathTasks-Grade5-Unit2

Comments:
These games should be played multiple times for students to begin to develop strategies for number placement. Students should discuss their strategies for playing the game and any problems they encountered. For example, students may roll several smaller (or larger) numbers in a row and must decide where to place them. Or, they may need to decide where to place any given number such as a 3.
Variations:

- Students could also try to make the least number by playing the game "Low Roller."
- Players could keep score of who created the greatest or least number during the game.
- Students could be required to write the word name, read the number aloud, or write the number in expanded notation.

These games can also be played with the whole class. The class can be divided into two teams and a student from each team can take turns rolling the die or drawing a card. Students from each team would complete the numbers on a chart. Alternatively, the students can play individually against each other and the teacher. The teacher can play on the white board and use a think-aloud strategy when placing digits on the board. This provides students with an opportunity to reflect on the placement of digits.

There are three versions of "High Roller Revisited." Version 1 is easiest, and Version 2 is more difficult because it includes more place values. Version 3 is called "Smallest Difference," and it is the most difficult of all three versions. In "Smallest Difference," students use subtraction to compare their decimals instead of simply determining which number is bigger.

Students will follow the directions below for the three versions of the game.

High Roller Revisited –Version 1 (easiest)

- The object of each round is to use 4 digits to create the greatest number possible.
- Each player takes a turn rolling the die and deciding where to record the digit on their place value chart.
- Players continue taking 3 more turns so that each player has written 4 digits.
- Once a digit is recorded, it cannot be changed.
- Compare numbers. The player with the greatest number wins the round.
- Play 5 rounds. The player who wins the most rounds wins the game.

High Roller Revisited –Version 2 (more difficult than Version 1)

- The object of each round is to use 10 digits to create the greatest number possible.
- Each player takes a turn rolling the die and deciding where to record the digit on their place value chart.
- Players continue taking 9 more turns so that each player has written 10 digits.
- Once a digit is recorded, it cannot be changed.
- Compare numbers. The player with the greatest number wins the round.
- Play 5 rounds. The player who wins the most rounds wins the game.

Smallest Difference Game-High Roller Revisited, Version 3 (most difficult version)

Version 3 of this game can be played with a variety of configurations. Students can use the configuration shown below. Different variations of the game board can be created using more or fewer number of place values.

Directions:

- In each round, players must write a number sentence in which the first number is greater than the second number. Next, players will subtract the smaller number from the greater number. The object of each round is to have the smallest difference between the two numbers.

Note:
If a player ends up with a false statement (i.e. the first number is not greater than the second number), then the player needs to switch the inequality sign so that the number sentence is correct and subtract the two numbers. But that student cannot win that round.

- Each player takes a turn rolling the die and deciding where to record the digit on their place value chart.
- Players continue taking 7 more turns so that each player has written 8 digits.
- Once a digit is recorded, it cannot be changed.
- After each player calculates the difference between their numbers, the player with the smallest difference wins the round.
- Play 5 rounds. The player who wins the most rounds wins the game.

<u>Number Talk:</u>

Strategy: Breaking Factors into Smaller Factors

Breaking factors into smaller factors instead of addends can be a very efficient and effective strategy for multiplication. The associative property is at the core of this strategy. It is a powerful mental strategy – especially when problems become larger and one of the factors can be changed to a one-digit multiplier.

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12 x 25 (4 x 25) + (4 x 25) + (4 x 25) 100 + 100 + 100 = 300	Students will often approach a problem such as 12 x 25 by breaking the 12 into 3 groups of 4. They are comfortable with money amounts, and they will notice that four quarters are equal to one dollar.
(4 x 25) + (4 x 25) + (4 x 25) = 3 x (4 x 25) 12 x 25 = 3 x (4 x 25)	Help them connect their thinking to the associative property by recording the problem as 3 x (4 x 25). Encourage them to discuss whether 12 x 25 is the same as 3 x 4 x 25. This is one way to begin making a bridge into factors and using the associative property.
12 x 25 12 x (5 x 5) = (12 x 5) x5 60 x 5 = 300	We can also use the associative property and knowledge about factorization to think of 25 as 5 x 5.

Below are two Breaking Factors into Smaller Fraction Number Talks for you to try with your students:

5 x 2 x 4	6 x 5 x 7 x 3
4 x 5 x 2	9 x 5 x 2 x 7
2 x 2 x 5 x 2	7 x 5 x 2 x 9
8 x 5	18 x 35

**For this particular number talk it would be good to incorporate a discussion about place value. This will help with a smooth transition into the task.

For more Number Talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:
It is important to use the language of fractions in the decimal unit because when students begin learning about decimals in fourth grade, they learn that fractions that have denominators of 10 can be written in a different format as decimals. In 5th grade, this understanding of decimals is extended to additional fractions with denominators that are powers of 10. For example:

- Read 0.003 as 3 thousandths, 0.4 as 4 tenths, which is the same as they would be read using fraction notation
- Read 0.2 + 0.03 = 0.23 as “2 tenths plus 3 hundredths equals 23 hundredths”
- This is the same as 0.20 + 0.03 = 0.23, read as “20 hundredths and 3 hundredths is 23 hundredths”

A common misconception that students have when trying to extend their understanding of whole number place value to decimal place value is that as you move to the left of the decimal point, the number increases in value. Reinforcing the concept of powers of ten is essential for addressing this issue.

A second misconception that is directly related to comparing whole numbers is the idea that the longer the number, the greater the number. With whole numbers, a 5-digit number is always greater that a 1-, 2-, 3-, or 4-digit number. However, with decimals, a number with one decimal place may be greater than a number with two or three decimal places. For example, 0.5 is greater than 0.12, 0.009 or 0.499. One method for comparing decimals is to make all numbers have the same number of digits to the right of the decimal point by adding zeros to the number, such as 0.500, 0.120, 0.009 and 0.499. A second method is to use a place-value chart to place the numerals for comparison.

Formative Assessment Questions:
• What strategies are you using when deciding where to place a high number that you rolled? Low numbers?
• What factors are you considering when you decide where to place a 1?
• What factors are you considering when you decide where to place a 3 or 4 (when using a six-sided die)?
• How do you decide where to place a 6 (when using a six-sided die)?

Differentiation:

Extension

- Have students write about “winning tips” for one of the games. Encourage them to write all they can about what strategies they use when they play.

Intervention

- Prior to playing the game, give students 9 number cards at once and have them make the largest number they can. Let them practice this activity a few times before using the die and making decisions about placement one number at a time.

Vocabulary:

Place Value	Tenths	Hundredths	Thousandths
Difference	Greatest	Least	

References:
Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Money For Chores

Content Standard

- **5.NBT.3.** Read, write, and compare decimals to thousandths.

a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form [e.g., 347.392 = 3 x 100 + 4 x 10 + 7 x 1 + 3 (1/10) + 9 (1/100) + 2 (1/1000)].

b. Compare two decimals to thousandths place based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

- **5.NBT.4.** Use place values understanding to round decimals to any place.

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description

In this task students will construct a bar graph showing the batting averages of Atlanta Braves baseball players and answer questions about the data. They will order, compare, and round the decimals in the problem.

Materials:

- Batter Data
- "Batter Up!" Recording Sheet
- Centimeter graph paper
- Crayons, colored pencils, or markers

****Please visit link below for batter data and recoding sheet (pg. 64):**
[MathTasks-Grade5-Unit2]

Comments

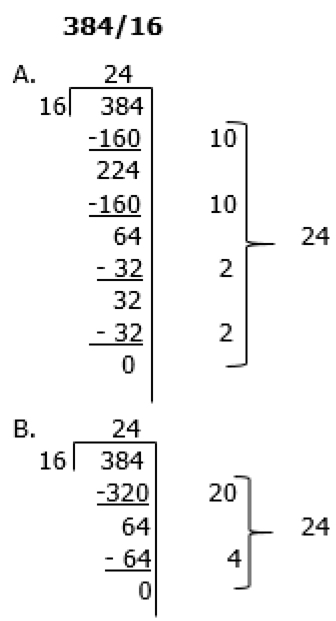
This task can be introduced with an explanation of batting averages and how they are computed (# of hits per 1,000 at-bats). They can construct the graph using graph paper with each square representing a portion of the decimal number. Students should be allowed to experiment and decide the appropriate interval.

Task Directions
Students will follow the directions below from “Batter Up!” student recording sheet. Using the data in the table, construct a bar graph showing the batting averages of these National League batting champions. You will need graph paper and markers, colored pencils, or crayons. Using the data and the graph, answer the questions on the recording sheet. Then students will follow the directions below from the “Batter Up!” student recording sheet.

<u>Number Talk:</u>
Strategy: Partial Quotients
Like the Partial Products strategy for multiplication, this strategy maintains place value and mathematically correct information for students. It allows them to work their way toward the quotient by using friendly multipliers such as tens, fives and twos without having to immediately find the largest quotient. As the student chooses larger multipliers, the strategy becomes more efficient.

Check below for example.

*To connect this strategy to the task, discuss the process of division when finding averages. .



When learning the procedure for the standard U.S. algorithm, students are often told that 16 cannot go into 3 (300), which is incorrect; 16 can divide into 3, but it would result in a fraction. With the Partial Quotients strategy, the “3” maintains its value of 300 and can certainly be divided by 16.

As the student works, he keeps track of the partial quotients by writing them to the side of the problem. When the problem is solved, the partial quotients are totaled and the final answer is written over the dividend.

Example A demonstrates using friendly 10s and 2s to solve the problem. As the 10s and 2s are recorded to the side of the problem, they represent 10 x 16 and 2 x 16.

Example B demonstrates a more efficient way to solve this problem.

Below are two Partial Quotients Number Talks for you to try with your students..

40/4	5/5
16/4	10/5
56/4	25/5
	50/5
	77/5

For additional number talks using this strategy please visit *Number Talks* by Sherry Parrish

Background Knowledge/Common Misconceptions:

Students should be familiar with constructing bar graphs from raw data. They may need to review the vocabulary associated with graphs.

Formative Assessment Questions:

- How will you choose a scale for the graph? Is your scale reasonable?
- How will you show what each bar represents?
- How does rounding to hundredths affect the averages?

Differentiation:

Extension

- Explain why rounding batting averages would not be a good idea for the players.
- What might happen if a player missed half of the season with an injury? How would it affect his batting average?

Intervention

- Allow students to work with a partner.
- Allow students to use a calculator.

Vocabulary:

Bar graph	Scale	Compare	Round
Tenths	Hundredths	Thousandths	

References:

Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Hit The Target

Content Standard

- **5.NBT.3.** Read, write, and compare decimals to thousandths.

a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form [e.g., 347.392 = 3 x 100 + 4 x 10 + 7 x 1 + 3 (1/10) + 9 (1/100) + 2 (1/1000)].

b. Compare two decimals to thousandths place based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description
Students will participate in a game using mental strategies to add decimal numbers.

Materials:
- Decimals master
- Card stock
- Calculators

****Please visit link below for decimal cards (pg. 69):**
MathTasks-Grade5-Unit2

Comments
Students will draw cards with decimal numbers and use mental math to check who can get closest to the whole number 1 without going over. Explain to students that they should draw cards from the stack and add the numbers mentally; stopping when they think the total is close to one. Have them check their work with a calculator to determine which one is closest to one without going over. They may need to subtract to determine the closest answer. Each time a student is closest to the target, he/she earns a point. They may total their points at the end of a session to determine an overall winner, or they may continue the game for several sessions. Each student should write in their math journal about the strategy they used for determining the number closest to one.

Task Directions

1. Model with the Class, using think-alouds.
2. Tell students they will be using mental strategies to “Hit the Target”.
3. Explain to student that they will be trying to hit the target of 1 by mentally adding decimal numbers to get as close to 1 as possible without going over.
4. Demonstrate with the whole class by calling out 2 decimal numbers and having them mentally add the numbers. Use the numbers 0.12 and 0.78.
5. Have them decide whether to ask for another number, or to stop.
6. If they ask for another number give them 0.04, then 0.23.
7. Show students the totals after each addition and ask them to explain how they could determine they were close enough to 1.

Group Task

1. Divide the class into groups of 3 or 4 students.
2. Have one student in each group act as leader. Direct this student to use the calculator to check answers.
3. Have each student in the group draw 2 cards and add them mentally.
4. Let each student decide whether to draw additional cards or stop.
5. When all students have stopped, have the leader use a calculator to determine which student is closest to 1.
6. Each time a student is closest to the target, he or she earns a point.
7. Have students change roles at the end of each round.

Number Talk:

Strategy: Breaking Each Number into Its Place Value

Once students begin to understand place value, this is one of the first strategies they utilize. Each addend is broken into expanded form and like place-value amounts are combined. When combining quantities, children typically work left to right because it maintains the magnitude of the numbers.

For example::

$116 + 118$	Each addend is broken into its place value.
$(100 + 10 + 6) + (100 + 10 + 8)$	
$100 + 100 = 200$	100’s are combined.
$10 + 10 = 20$	10’s are combined.
$6 + 8 = 14$	1’s are combined.
$200 + 20 + 14 = 234$	Totals are added from the previous sums

Below is a Breaking Each Number into Its Place Value Number Talk for you to try with your class

$28 + 11$	$15 + 27$
$14 + 35$	$17 + 25$
$22 + 15$	$23 + 18$
$18 + 31$	$16 + 27$

For additional number talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:

Students should be able to estimate sums and differences, using mental math. They should have a clear understanding of the value of decimal numbers, and their relative relationship to one.

Formative Assessment Questions:

- How did you decide when you were close enough to 1?
- What method did you use to estimate your answer?
- Is it easier to estimate tenths or hundredths? Why?
- Did anyone use a different strategy?
- What operation did you use to help you?

Differentiation:

Extension

- Change the target number to a whole number other than 1.
- Use a decimal number greater than 1

Intervention

For students who need additional practice in building better estimation skills, begin the game with only tenths cards. Then add hundredths and thousandths gradually.

Vocabulary:

Strategy	Estimate	Tenths
Hundredths	Decimal	Operation

References:
Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Alaska Mathematics Standards
Math Tasks Grade 5

Power-ful Exponents

Content Standard

- **5. NBT.2.** Explain and extend the patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain and extend the 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.

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description

Students will develop an understanding that place value can be expressed as a power of 10 (exponents). They will also explore exponential multiplication as a very powerful operation that can create very large numbers. (Task adapted from *NZ math resource beyond-million-amazing-math-journey*)

Materials:

- Suggested literature: *On Beyond a Million: An Amazing Math Journey* by David M. Schwartz
- “Place Value Houses” recording sheets
- Six sided dice
- Calculator
- “Powers of 10 Yahtzee” recording sheet

****Please visit link below for recording sheets (pg. 16):**
MathTasks-Grade5-Unit3

Comments:
This task provides students with the opportunity to explore the different ways to express powers of 10 through a suggested literature connection. Instead of teaching this concept procedurally, allow students to discover the relationship between the powers of 10 and the number of zeros in a number with a 1 in the highest place and zeros in the rest.

Part 1
Prior to reading the story, ask: What is the largest number you can read? Record a number with many places such as 1,234,567,890,123,456,789 or 1,000,000,000,000 and explore the understanding of place value "houses" with your students. Use the place value houses and insert the digits in the places and practice reading the numbers, stressing to remember to name the house before you leave for the next one (example 42,509,670 read as 42 MILLION, 509 THOUSAND, 670). The first time that you share the book with your students, start by sharing the story told in the middle sections of the 2-page spreads and focusing on the new vocabulary of the large numbers and the idea of infinity.

Next, or in a second session, read through the book again, this time focusing on the idea of exponents and the math being explored by the professor's dog on the sidebars. Have students record the numbers expressed as exponents and as ordinary notation. Revisit the Place Value houses and in each section of the house record the place as an expression of a power of ten.

Explore this pattern with the rest of the standard place value houses. Support students to discover the link between powers of 10 and the number of zeros in any large number which has a 1 in the highest place and zeros in the rest.

Part 2
Students will play "Powers of 10 Yahtzee."

Directions:

- Students play against an opponent. The pair needs one die.
- Players take turns rolling the die until each has rolled the die 5 times. Each time they roll the die, they are rolling a power of 10. The base number is always 10. The object of the game is to have the greatest sum after rolling five numbers.
- Player 1 rolls the die, writes the number as 10 to whatever power is indicated on the die and finds the value for that expression. Both players write the exponential expression on their recording sheets and may check the solution with a calculator.
- It is then player 2's turn to roll the die, write the expression and find the value.
- The players continue taking turns until each has had 5 turns. Players record both the five turns for player one and the five turns for player two. At that point the players each find the sum of their answers. The player with the greatest sum wins.

Number Talk:

Strategy: Partial Products

This strategy is based on the distributive property and is the precursor for our standard U.S. algorithm for multiplication – it just keeps the place value intact. The strategy more closely resembles the algorithm when written vertically. When students understand that the factors in a multiplication problem can be decomposed or broken apart into addends, this allows them to use smaller problems to solve more difficult ones. As students invent Partial Product strategies, they can break one or both factors apart.

12×15		12×15	
Horizontal 12×15 $12 \times (10 + 5)$ $12 \times 10 = 120$ (12×10) $12 \times 5 = 60$ (12×5) $120 + 60 = 180$ Vertical $\begin{array}{r} 15 \\ \underline{\times\ 12} \\ 120 \\ \underline{+60} \\ 180 \end{array}$	Whether the problem is written horizontally or vertically, the fidelity of place value is kept. In this example, the 15 is thought about as (10 + 5) while the 12 is kept whole.	12 x 15 (4 + 4 + 4) x 15 4 x 15 = 60 4 x 15 = 60 4 x 15 = 60 60 + 60 + 60 = 180 12 x 15 (10 + 2) x (10 + 5) 10 x 10 = 100 10 x 5 = 50 2 x 10 = 20 2 x 5 = 10 100 + 50 + 20 + 10 = 180	This time the 12 is broken apart into (4 + 4 + 4) and the 25 is kept whole. The 12 could have been broken into (10 +2) or any other combination that would have made the problem accessible. Both factors can be broken apart, and as numbers become larger, students often use this method until they become more confident in multiplying with larger quantities. It is difficult for some students to keep up with all of the parts of the problem, especially when trying to use this strategy without paper and pencil.

Below are two Partial Products Number Talks for you to try with your students.

4 X 22 6 X 11 3 X 22 6 X 22 10 X 22 16 X 22	5 X 30 10 X 30 3 X 15 10 X 15 15 X 33

For additional Number Talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:

This lesson will extend students' previous experience with whole number place value.

Before doing this activity, students should have an understanding of the place value names, the period names, and the values associated with them. They should also have prior experiences multiplying whole numbers by powers of ten in Unit 1. In this activity, they will extend that to multiply decimals by powers of ten.

- Multiplication can increase or decrease a number. From previous work with computing whole numbers, students understand that the product of multiplication is greater than the factors. However, multiplication can have a reducing effect when multiplying a positive number by a decimal less than one or multiplying two decimal numbers together. We need to put the term multiplying into a context with which we can identify and which will then make the situation meaningful. Also using the terms times and of interchangeably can assist with the contextual understanding.

- Is a x a x a = 3a? Is a3 = a x 3? In mathematics each symbol has a uniquely defined meaning. a x 3 has been arbitrarily chosen as shorthand for a + a + a. It cannot mean anything else. a3 has been, equally arbitrarily, chosen as shorthand for a x a x a. It means precisely this. Always consider the unique meanings of the mathematics you write.

<u>Formative Assessment Questions:</u>

- Did you develop a shortcut to find your answers?
- Did you identify any patterns or rules? Explain!

<u>Differentiation:</u>

Extension

- Students can explore writing large numbers in scientific notation.
- Students can research large numbers and the meaning of their names.

Intervention

- Most students, including students needing an intervention here, would benefit from the use of base ten materials. For example, 102 would mean taking ten sets of tens. Students would put these together to make another base ten material, in this case the 100 (flat). For larger exponents, students would still find a cube, rod, or flat, since that is the pattern found in the base ten materials.
    - For example, 105 would mean taking 10 sets of 10 rods, which as we found before, makes a 100 flat, then taking 10 sets of 100 flats to make a 1,000 cube, then ten thousands cubes to make a 10,000 rod, then ten 10,000 rods to make a 100,000 flat. It is likely that students won't be able to make some of these with actual materials, but it does provide students with an investigation into the order of magnitude of our base ten system.

<u>Vocabulary:</u>

Place Value	Expression	Value	Ones
Tens	Hundreds	Thousands	Power of 10
Sum			

References:

Parrish, Sherry. <u>Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5</u>. Sausalito: Math Solutions Publications, 2010

The Hiking Trail

Content Standard

- **5.NF.3.** Interpret a fraction as division of the numerator by the denominator (a/b = a ÷ b). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers (e.g., by using visual fraction models or equations to represent the problem). *For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?*
- **5.NF.4.** Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.
  a. Interpret the product (a/b) × q as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations a × q ÷ b. *For example, use a visual fraction model to show (2/3) × 4 = 8/3, and create a story context for this equation. Do the same with (2/3) × (4/5) =8/15. (In general, (a/b) × (c/d) = ac/bd.)*
  b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description
Students will explore the concept of equivalent fractions, and develop strategies to find equivalent fractions. (Adapted from *Contexts for Learning Mathematics Fractions, Decimals, and Percents* by Fosnot, Catherine Twomey et.al.)

Materials:

- Copy of the Task The Hiking Trail (1 per pair of students or small group)
- Pencil
- Ruler (60 inch tape measure or yardstick)
- Accessible manipulatives

****Please visit link below for task sheet (pg. 53):**
MathTasks-Grade5-Unit4

Introduce the problem and be sure everyone is clear with the context. Let students know that they will be designing a hiking trail for a four day Hike-a-thon. The trail is 6.0 km and is in the GA Mountains. The committee has decided what kind of informational markers and how often they should be placed. Your task is to figure out where to put informational markers along the way.

- A Camping area and Food Wagons should be at each fourth of the trail.
- Resting Points should be at every eighth of the trail.
- Water Stations should be at every tenth of the trail.
- Juice and Snack Tables should be at every fifth of the trail.
- Recycling and Trash Bins should be placed at every marker
- Kilometer Markers should be placed along the trail, so that hikers know how much of the course they've completed. These markers should be placed at every twelfth, sixth, and half of the course, as well as at all of the other locations above. These markers should show how many kilometers have been completed. Give pairs of students sixty inch measuring tapes or yard sticks. Have the pairs draw a sixty inch hiking trail on some butcher paper.

Students may use a variety of strategies including, but not limited to:

- Halving. They may take half of the halves to find fourths, and take half of the fourths to find eighths.
- Dividing by the denominator. Students may think of 1/5 of 6.0 = 6.0/5
- Adding parts. Students may think about 3/8 as 1/8 more than 2/8.
- Use equivalence ideas developed in the ratio table task earlier. Students may say 6/8 = 3/4 since 3 x 2= 6 and 4 x 2= 8

Number Talk:

Strategy: Proportional Reasoning

As students become stronger with their understanding of factors, multiples, and fractional reasoning, they may look at division from a proportional reasoning perspective. If students have had experiences with doubling and halving to solve multiplication problems, they will often wonder if the same approach will work with division. This is an excellent way to launch an investigation to lead to the idea that you can divide the dividend and divisor by the same amount to create a simpler problem. If the dividend and divisor share common factors, then the problem can be simplified.

384 ÷ 16 384 ÷ 16 ÷ 2 ÷ 2 192 ÷ 8	Both 384 and 16 share the common factors of 2, 4, and 8. Let's simplify each number by dividing by 2.	384 ÷ 16 = 24 192 ÷ 8 = 24 96 ÷ 4 = 24 48 ÷ 2 = 24	We would have arrived at the correct answer of 24 with any of the problems.
192 ÷ 8 ÷ 2 ÷ 2 96 ÷ 4	As we divide each number by 2, the problem becomes 192/8. While this is a simpler problem than the original, we can still simplify each number by 2 since they are both even numbers.	$\frac{384}{16} = \frac{192}{8} = \frac{96}{4} = \frac{48}{2}$	It may be helpful to think of this sequence of division problems as equivalent fractions .
96 ÷ 4 ÷ 2 ÷ 2 48 ÷ 2	We can continue to divide by 2 to create an even smaller problem, or solve the problem whenever the numbers are easier to use.		

Below are two Proportional Reasoning Number Talks for you to try with your students.

$\frac{308}{7}$ $\frac{308}{14}$ $\frac{308}{28}$	$\frac{172}{3}$ $\frac{144}{6}$ $\frac{288}{12}$

For additional Number Talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:

This task was developed from *Contexts for Learning Mathematics*, by Fosnot and Jacob. Students engaging in this task have a deep understanding of fractions and the beginnings of fraction sense fostered in previous tasks. If students need additional support in developing this fraction sense, support students with activities from

Teaching Student-Centered Mathematics, by John A Van de Walle and Lou Ann Lovin., pgs. 144 –146 (activities 5.6 –5.10).

Students may believe that multiplication always results in a larger number. Using models when multiplying with fractions will enable students to check that the results will be smaller. Additionally, students may believe that division always results in a smaller number. Using models when dividing with fractions will enable students to understand that the results will be larger.

Formative Assessment Questions:

- How can you tell that your map is accurately drawn to scale? Explain.
- Justify why your map has the best marker placement for the hiking trail.
- How do you know that marker goes there? Show me your thinking.
- How can you tell that your markers are in the correct place? Is there another way to think about this?
- Did you develop a shortcut to find your answers?
- Did you identify any patterns or rules? Explain what you have found!

After enough time has been devoted to the task, hang the work around the room and have students taken some time to view and make comments on others' work. Students may ask questions, or make mathematical commentary on post-it notes and stick them to the work. Pay attention to students' talk and make note of what is discussed during this time as it may give you some ideas about who should share and in what order they should share. When students have finished the tour, come back to the large group and begin the closing of the lesson. The goal of this closing is to help students make generalizations about equivalent fractions. Help students reach this goal, not by telling, but by asking thought provoking questions about the work.

Differentiation:

Extension

- Students who are ready for an extension of this lesson can connect it to geography by using a map of the GA Mountains and using map/math skills to highlight a 6.0 km trail.

Intervention

- Students requiring intervention should have access to manipulatives and, like all other students, share their thinking. All misconceptions are potential learning points for all students. In addition, students requiring intervention should be given a distance of 60 km, rather than 6.0 km, to build their understanding of fractions of whole numbers without the potential decimal as a response. In the closing, the connection between 60 km and 6.0 km (as well as the solutions to the problem) should be made by students through careful teacher questioning.

Vocabulary:

Equivalent Fractions Denominator Numerator Committee

References:

Fosnot, Catherine Twomey, and Bill Jacob. Contexts for Learning Mathematics. Portsmouth: Heinemann, 2007
Van de Walle, John A., Lou Ann H. Lovin. Teaching Student-Centered Mathematics: Grades 3-5, Volume 2. Pearson, 2006
Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Flip It Over

Content Standard

- **5.NF.1.** Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)*

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description

This task was developed to help students develop and use relationships between certain fractions for fraction computation. It is designed to allow students to develop these relationships for fluency and understanding of fractional computation.

Materials:

- Game board
- Two counters per person
- Available manipulatives

****Please visit link below for game board and all other printables that you will need to complete this task (pg. 79):**
MathTasks-Grade5-Unit4

In this task students will play a game to check who can flip over their cards first. This game will allow students to use their fractional understandings and build their fractional computation strategies. Logical thinking and problem solving skills will begin to develop as students devise strategies for playing the game.

Comments

Multiple fraction models, in addition to those included in the task, should be made available to the students as support for those who need it. In addition, fractional number lines (or open number lines) could benefit many students with this task. This task could be introduced in a small group or by playing with class as a whole using available technology. In addition, the teachers could role model with a student, or better yet have two students role model how to play for the rest of the class. Before asking students to work on this task, be sure students are able to:

- Use models to create equivalent fractions (visit previous tasks and Van de Walle's *Teaching Student Centered Mathematics*, volume 2, pg. 155-156 (Slicing Squares)).
- Understand that a whole can be written as a fraction with any number of parts as long as all of those parts are included to make the whole. For example, a whole can be cut into tenths. In order to have a whole, I need all ten tenths (10/10).
- Be able to decompose fraction, for example 4/4 = 1/2 + 1/2 or 1/4 + 3/4

Task Directions

Students will follow directions below from the Create Three Game activity.
Play the game several times. Keep track of computation strategies used (use models in explanations during the closing). Keep track of game playing strategies used (if any develop this first time playing).

Questions for Teacher Reflection While planning the task:

- What level of support do my struggling students need in order to be successful with this task?
- In what way can I deepen the understanding of those students who are competent in this task?
- Could this game be played again, or changed in any way?

During and after the students complete the task:

- Which students have developed a strategy based on fraction understandings of numerators and denominators?
- Which students are becoming fluent in creating equivalent fractions when adding fractions?
- Which students still prefer to use manipulatives and rely heavily on models?

Questions for Teacher Reflection:

- How did my students engage in the 8 mathematical practices today?
- How effective was I in creating an environment where meaningful learning could take place?
- How effective was my questioning today? Did I question too little or say too much?
- Were manipulatives made accessible for students to work through the task?
- One positive thing about today's lesson and one thing you will change?

<u>Number Talk:</u>

**Beginning this task with a number talk centered around multiplication should help students make a smooth transition into recognizing and creating equivalent fractions.

Strategy: Breaking Factors into Smaller Factors

Breaking factors into smaller factors instead of addends can be a very efficient and effective strategy for multiplication. The associative property is at the core of this strategy. It is a powerful mental strategy – especially when problems become larger and one of the factors can be changed to a one-digit multiplier.

12 x 25 (4 x 25) + (4 x 25) + (4 x 25) 100 + 100 + 100 = 300	Students will often approach a problem such as 12 x 25 by breaking the 12 into 3 groups of 4. They are comfortable with money amounts, and they will notice that four quarters are equal to one dollar.
(4 x 25) + (4 x 25) + (4 x 25) = 3 x (4 x 25) 12 x 25 = 3 x (4 x 25)	Help them connect their thinking to the associative property by recording the problem as 3 x (4 x 25). Encourage them to discuss whether 12 x 25 is the same as 3 x 4 x 25. This is one way to begin making a bridge into factors and using the associative property.
12 x 25 12 x (5 x 5) = (12 x 5) x5 60 x 5 = 300	We can also use the associative property and knowledge about factorization to think of 25 as 5 x 5.

Below are two Breaking Factors into Smaller Fraction Number Talks for you to try with your students.

2 X 3 X 3 X 3 3 X 6 X 3 9 X 3 X 2 6 X 9	5 X 2 X 6 5 X 4 X 3 2 X 2 X 3 X 5 5 X 12

For additional Number Talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:

Students may think that they should add the numerators and then the denominators. They may lack understanding about the relative value of the fractions themselves.

Formative Assessment Questions:

- What fractions do you find easy to work with? Why?
- Which fraction do you like to spin? Why?
- What strategies do you use when playing this game?

Vocabulary:

Equivalent Fractions	Sum	Numerator
Difference	Denominator	

References:

Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Van de Walle, John A., Lou Ann H. Lovin. Teaching Student-Centered Mathematics: Grades 3-5, Volume 2. Pearson, 2006

Air Traffic Controller

<u>**Content Standard**</u>

- **5.G.1.** Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).
- **5.G.2.** Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

<u>**Mathematical Practices**</u>

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

<u>**Task Description**</u>
Students work to write expressions and solve equations

Materials:

- "Air Traffic Controller" recording sheet
- Floor grid (could be created with tiles on the floor) or shower curtain grid
- One Person to be the air traffic controller
- Three people to be airplanes
- Colored pencils/markers

****Please visit link below for recording sheet and other materials that accompany this task (pg. 24):**
[Math Tasks grade 5 Unit-5.pdf]

Comments:
Identifying points on a coordinate grid is important in understanding how the coordinate system works and in constructing simple line graphs to display data or to plot points. These skills further help us to examine algebraic functions and relationships. The skills developed in this lesson can be applied cross-curricular to reading latitude and longitude on a map and to plotting data points.

Getting Started:

1. The Air Traffic Controller tells the planes where they need to go using coordinates on the grid.
2. Each plane enters the grid at the origin (0, 0). This is where the Air Traffic Controller's radar first picks up each plane's signal. Once the Air Traffic Controller "sees" a plane, he or she must tell them where to go using coordinates.
3. The Air Traffic Controller is responsible for keeping the planes, pilots, and their passengers safe from collisions with other aircrafts.
4. The more planes there are in the sky, the more difficult it is to keep planes safe.
5. Each Air Traffic Controller has to keep track of each plane by doing the following:
   - Each plane's name must be written on the recording sheet.
   - The coordinates for the path that each plane takes must be written down.
   - The Air Traffic Controller must draw a flight plan on the recording sheet for each plane. Each plane must go from point A (0, 0) to the final destination or landing strip, point B (10, 10).
   - Submit both the coordinates and the flight plan to the FAA President (Your Teacher) at the end of this exercise.
6. The job of Air Traffic Controller passes from one person to the next until all students have had the job. Once students have constructed their flight plan, the group may move to the floor grid or shower curtain grid to make sure all planes will land safely.

Finishing Up:
Air Traffic Controllers:
Before you turn in your flight paths and coordinates, please be sure to complete the following:

1. Highlight or shade each plane's flight path a different color with a key at the bottom that shows which color represents each plane.
2. Put your name on your papers.
3. Turn them in to the FAA President.

<u>Number Talk:</u>
Even though this task involves geometry standards, it is still important to practice number talks daily. There is an example of a number talk appropriate for 5th grade below. However, feel free to choose or create a number talk that is relevant and/or needed for the students in your classroom.

Strategy: Proportional Reasoning
As students become stronger with their understanding of factors, multiples, and fractional reasoning, they may look at division from a proportional reasoning perspective. If students have had experiences with doubling and halving to solve multiplication problems, they will often wonder if the same approach will work with division. This is an excellent way to launch an investigation to lead to the idea that you can divide the dividend and divisor by the same amount to create a simpler problem. If the dividend and divisor share common factors, then the problem can be simplified.

$384 \div 16$ $\begin{array}{ccc} 384 & \div & 16 \\ \underline{\div 2} & & \underline{\div 2} \\ 192 & \div & 8 \end{array}$	Both 384 and 16 share the common factors of 2, 4, and 8. Let's simplify each number by dividing by 2.	$384 \div 16 = 24$ $192 \div 8 = 24$ $96 \div 4 = 24$ $48 \div 2 = 24$	We would have arrived at the correct answer of 24 with any of the problems.
$\begin{array}{ccc} 192 & \div & 8 \\ \underline{\div 2} & & \underline{\div 2} \\ 96 & \div & 4 \end{array}$	As we divide each number by 2, the problem becomes 192/8. While this is a simpler problem than the original, we can still simplify each number by 2 since they are both even numbers.	$\frac{384}{16} = \frac{192}{8} = \frac{96}{4} = \frac{48}{2}$	It may be helpful to think of this sequence of division problems as equivalent fractions .
$\begin{array}{ccc} 96 & \div & 4 \\ \underline{\div 2} & & \underline{\div 2} \\ 48 & \div & 2 \end{array}$	We can continue to divide by 2 to create an even smaller problem, or solve the problem whenever the numbers are easier to use.		

Below are two Proportional Reasoning Number Talks for you to try with your students.

$\frac{250}{2}$ $\frac{500}{4}$ $\frac{1000}{8}$	$\frac{800}{40}$ $\frac{80}{4}$ $\frac{40}{2}$

For additional Number Talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:

Students need to know the difference between vertical (y-axis) and horizontal (x-axis) lines and how locate and name points in the first quadrant of the coordinate plane.

- Students reverse the points when plotting them on a coordinate plane. They count up first on the y-axis and then count over on the x-axis. The location of every point in the plane has a specific place. Have students plot points where the numbers are reversed such as (4, 5) and (5, 4). Begin with students providing a verbal description of how to plot each point. Then, have them follow the verbal description and plot each point.

- When playing games with coordinates or looking at maps, students may think the order in plotting a coordinate point is not important. Have students plot points so that the position of the coordinates is switched. For example, have students plot (3, 4) and (4, 3) and discuss the order used to plot the points. Have students create directions for others to follow so that they become aware of the importance of direction and distance.

Formative Assessment Questions:

- What is the coordinate for the horizontal (x-axis) and vertical (y-axis) axis?
- Why do you need to plot your point where two lines intersect?
- How do you graph and name a point on the coordinate plane?
- Explain how you used an ordered pair to locate a point on the coordinate plane?

Differentiation:

Extension

- This task can be extended by giving students an opportunity create flight plans for planes ahead of time. Once the students have their plans, they must enter the "radar map" one at a time, moving at a consistent pace. Planes take turns moving from one point to the next, following the flight plan. The students must follow their flight plan, and the "Air Traffic Controller" must facilitate this, should there be any confusion.

Intervention

- If students are still struggling with plotting points on the coordinate plane, there are two activities in Van de Walle's *Elementary and Middle School Mathematics Teaching Developmentally*: Activity 20.21 "Hidden Positions" and Activity 20.22 "Paths".

Vocabulary:

X-axis	Coordinates	Ordered Pair
Y-axis	Horizontal	Traffic Controller
Intersect	Vertical	

References:

Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Van de Walle, John A., Karen S. Karp, Jennifer M. Bay-Williams. Elementary and Middle School Mathematics: Teaching Developmentally. Pearson, 2012

First To Arrive

Content Standard

- **5.OA. 3.** Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.
  For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.
- **5.G.1.** Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).
- **5.G.2.** Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description
In this task, students will determine which vehicle will arrive at a destination first based on the speed traveled.

Materials:

- "First to Arrive" recording sheet
- Centimeter grid paper

****Please visit link below for recording sheet (pg. 42):**
MathTasks-Grade5-Unit7

Two vehicles are traveling along the same path for 5 hours. Vehicle A is traveling at a rate of 30 miles per hour. Vehicle B is traveling at a rate of 60 miles per hour. At the completion of the trip, which vehicle will have traveled the farthest? How much farther? Complete the tables and graph the data by creating a coordinate grid to justify your reasoning.

Car A: 30 MPH			Car B: 60 MPH	
Number of Hours	Total Miles:		Number of Hours	Total Miles:
0			0	
1			1	
2			2	
3			3	
4			4	
5			5	

Number Talk:
Even though this task involves geometry standards, it is still important to practice number talks daily. There is an example of a number talk appropriate for 5th grade below. However, feel free to choose or create a number talk that is relevant and/or needed for the students in your classroom.

Strategy: Multiplying Up
Similar to the Adding Up strategy for subtraction, the Multiplying Up strategy provides access to division by building on the student's strength in multiplication. Students realize that they can also multiply up to reach the dividend. This is a natural progression as they become more confident in their use and understanding of multiplication and its relationship to division. Initially, students may rely on using smaller factors and multiples, which will result in more steps. This can provide an opportunity for discussions related to choosing efficient factors with which to multiply.

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384÷16 10 x 16 = 160 10 x 16 = 160 2 x 16 = 32 2 x 16 = 32 10 + 10 + 2 + 2 = 24 24 x 16 = 384	This strategy allows students to build on multiplication problems that are comfortable and easy to use such as multiplying by tens and twos.	The open array can be used to model the student's strategy and link the operations of multiplication and division. 10 10 2 2 16 x 10 =160 16 x 10 =160 16 x 2 =32 16 x 2 =32 **16**

Below are two *Multiplying Up Number Talks* for you to try with your students.

25 x 10	7 x 100
25 x 4	7 x 10
25 x 2	7 x 5
840/25	7 x 2
	836/7

For additional Number Talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:

The teacher may want to review the meaning of miles per hour and how it relates to the problem. Students should have experience creating their own coordinate grid and graphing the points.

Students need to know the difference between vertical (y-axis) and horizontal (x-axis) lines and how locate and name points in the first quadrant of the coordinate plane.

- Students reverse the points when plotting them on a coordinate plane. They count up first on the y-axis and then count over on the x-axis. The location of every point in the plane has a specific place. Have students plot points where the numbers are reversed such as (4, 5) and (5, 4). Begin with students providing a verbal description of how to plot each point. Then, have them follow the verbal description and plot each point.
- When playing games with coordinates or looking at maps, students may think the order in plotting a coordinate point is not important. Have students plot points so that the position of the coordinates is switched. For example, have students plot (3, 4) and (4, 3) and discuss the order used to plot the points. Have students create directions for others to follow so that they become aware of the importance of direction and distance.

Formative Assessment Questions:

- What is the coordinate for the horizontal (x-axis) and vertical (y-axis) axis? Justify your answer.
- Why do you need to plot your point where two lines intersect?
- How do you graph and name a point on the coordinate plane based on the information in the table?
- Explain how you used an ordered pair to locate a point on the coordinate plane?
- Explain the relationships between the data in the two tables?

Differentiation:

Extension

- Adjust the task so both cars have already traveled a certain number of miles. For example, Car A has already traveled 15 miles and Car B has only traveled 5. After traveling, who would have traveled the farthest?

Intervention

- Allow students to work with a partner or small group.

Vocabulary:

Miles Per Hour	X-Axis	Horizontal	Intersect
Coordinate	Y-Axis	Vertical	Data

References:
Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Polygon Capture

Content Standard	Mathematical Practices
• **5.G.3.** Understand that attributes belonging to a category of two dimensional (plane) figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.	**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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets. 5. Use appropriate tools strategically. **6. Attend to precision.** **7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting** 8. Look for and express regularity in repeated reasoning.

Task Description

The purpose of this task is to motivate students to examine relationships among geometric properties. In this activity, students must choose figures according to a pair of properties, players go beyond simple recognition to an analysis of the properties and how they interrelate. (Adapted from *NCTM Illuminations*)

Materials:

- Polygon Capture Game Rules
- Polygon Capture Game Cards, (Copied onto cardstock)
- Polygon Capture Game Polygons, (Copied onto cardstock)

****Please visit link below for rules, game card and polygons (pg. 16):**
MathTasks-Grade5-Unit5

Comments:

The purpose of this task is to motivate students to examine relationships among geometric properties. According to Van Heile, the students move from recognition or description to analysis. When asked to describe geometric figures, students rarely mention more than one property or describe how two properties are related. In this activity, by having to choose figures according to a pair of properties, players go beyond simple recognition to an analysis of the properties and how they interrelate.

Prior to beginning the game, assess the students' familiarity with the vocabulary used in this game by engaging students in a class discussion in which they find examples, define, and/or illustrate the geometric terms.

1. Distribute copies of Polygon Capture Game Rules, Polygon Capture Game Cards, and Polygon Capture Game Polygons to each pair of students.
2. BEFORE CUTTING: The students should label each game card on the back to designate it as an "angle" or "side" card. The first eight game cards, or the top sheet, should be labeled "A" for angle property; the last eight game cards, or the bottom sheet, should be labeled "S" for side property. After labeling the game cards, the students may cut out the polygons and all game cards.
3. Basic Rules: Have the students read the rules on the Polygon Capture Game Rules sheet. Teachers have found it helpful to begin by playing the game together. Teacher vs. class. For the first game, remove the Steal Card to simplify the game.

To introduce the game as a whole-class activity, lay all twenty polygons in the center of the overhead projector. Students may lay out their shapes and follow along. An introductory game observed in one of the classroom proceeded as follows:

1. The teacher draws the cards, *All angles have the same measure and All sides have the same measure*. She takes figures D, G, Q, and S, placing them in her pile and out of play.
2. Students then pick the cards *At least two angles are acute* and *It is a quadrilateral*. They choose figures I, J, K, M, N, O, and R.
3. On her second turn, the teacher picks the cards *There is at least one right angle* and *No sides are parallel*. She chooses figures A and C and then asks students to find a figure that she could have taken but forgot. One student points out that figure H has a right angle and no parallel sides. Other students are not sure that this polygon has a right angle, which leads to a discussion of how they might check.
4. The students then proceed to take two new cards.

*When no polygons remain in play that matches the two cards chosen, the player may turn over one additional card-either an angle or a side card. This move calls for some planning and analysis to determine whether an angle card or a side card is most likely to be useful in capturing the most polygons. If the player still cannot capture any polygons, the play moves to the opponent. When all cards in a deck are used up before the end of the game, they are reshuffled. Play continues until two or fewer polygons remain. **The player with the most polygons is the winner.**

WILD CARD: When the "Wild Card" is selected, the player may name whatever side property he or she wishes; it need not be one of the properties listed on the cards. Again, a good strategy to capture the largest number of polygons requires an analysis of the figures that are still in play.

STEAL CARD: When the "Steal Card" comes up, a card from the deck is not drawn. Instead, the player has the opportunity to capture some of the opponent's polygons. The person who has chosen the Steal Card names two properties (one side and one angle) and "steals" the polygons with those properties from the opponent. The students may select their own properties, not necessarily those on the game cards. If the opponent has no polygons yet, the Steal Card is put back in the deck and a new card chosen.

NOTES: The various strategies that the students use will be interesting. Some students go through the figures one at a time, using a trial and error method. Some students perform two sorts; they find the polygons that match the first card and then the second. Others may mentally visualize the polygons that are possible.

Number Talk:
Even though this task involves a geometry standard, it is still important to practice number talks daily. There is an example of a number talk appropriate for 5th grade below. However, feel free to choose or create a number talk that is relevant and/or needed for the students in your classroom.

Strategy: Compensation
Similar to the Landmark of Friendly Numbers strategy, the goal of compensation is to manipulate the numbers into easier, friendlier numbers to add. The main difference between the two strategies is that when compensating, you removed a specific amount from one addend and give that exact amount to the other addend.

This is a big idea in addition and one that students will need many experiences to investigate. As long as the quantities are kept the same, you can remove and add any amount; however, a big decision for students is choosing which amount will produce the most efficient addends with which to work.

A. $\begin{array}{r} 116 \\ -\ \ 2 \\ \hline 114 \end{array} \quad \begin{array}{c} + \\ + \\ \ \end{array} \quad \begin{array}{r} 118 \\ 2 \\ \hline 120 \end{array} = 234$	In Example A, the student changes 118 to the friendly number of 120. Notice how 2 was subtracted from the 116 and then added to the 118.
B. $\begin{array}{r} 116 \\ +\ \ 4 \\ \hline 120 \end{array} \quad + \quad \begin{array}{r} 118 \\ -\ \ 4 \\ \hline 114 \end{array} = 234$	Example B demonstrates that the student could have also subtracted 4 from 118 and added it to 116.

Below is a Breaking Each Number into Its Place Value Number Talk for you to try with your class

$28 + 11$	$15 + 27$
$14 + 35$	$17 + 25$
$22 + 15$	$23 + 18$
$18 + 31$	$16 + 27$

For additional number talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:
The students will need to know the meaning of parallel, perpendicular, quadrilateral, acute, obtuse, and right.
Students think that when describing geometric shapes and placing them in subcategories, the last category is the only classification that can be used.

Formative Assessment Questions:
- How did decide which card to play?
- How did you decide which property to select?
- How did you sort your cards?
- How can you capture the most cards?

Differentiation:

Extension

- Some teachers have found that coordinating two properties is initially too difficult for their students and have simplified the game by placing all cards into a single pile. For this simpler version only one card is turned over, and students choose all polygons with that property. It is probably best to remove the WILD CARD and the STEAL CARD. The other rules are the same.
- The polygons figures on the Polygon Capture Game Polygons sheet can also be used for various sorting games and activities. For example, students may work in pairs, with one student separating the shapes into groups based on some rule or set of rules, and the other student trying to decide the rules.
- More polygons can be added by the students or teacher. These might include figures that are more complex to capture, such as a kite or non-convex hexagon. Non-polygons, such as figures with curves, can be added to the basic deck.

Intervention

- Use the polygon figures on the Polygon Capture Game Polygon sheet to review geometry vocabulary prior to playing the game.
- The Polygon Capture game cards can also be used to generate figures. As in the game, students turn over two cards. Instead of capturing polygons, they use a garboard or dot paper to make a figure that has the two properties. Rather than a game, this is simply an activity to help students learn to coordinate the features of a polygon.

Vocabulary:

Property	Polygon	Quadrilateral	Angle
Right Angle	Acute Angle	Parallel	

References:
Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Property Lists of Quadrilaterals

Content Standard

- **5.G.3.** Understand that attributes belonging to a category of two dimensional (plane) figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description

The purpose of this task is for students to become familiar with the properties of quadrilaterals. They will identify the attributes of each quadrilateral, then compare and contrast the attributes of different quadrilaterals (Adapted from Van De Walle, *Teaching Student-Centered Math* pg. 207)

Materials:

- Rulers
- Protractors
- Index cards
- Mirror, pipe cleaners or tooth picks (choose one to check lines of symmetry)
- Copies of Property List Sheets Blackline Masters 45-46 found at: **Black line master sheets assorted shapes** Chart Paper-(Class List) One chart per polygon for the students to record their answers after the presentations.

The purpose of this task is for students to become familiar with the properties of quadrilaterals. They will identify the attributes of each quadrilateral, then compare and contrast the attributes of different quadrilaterals.

Assign students to work in groups of three or four to one type of quadrilateral. The task is for the students to list as many properties as they can for their quadrilateral. The list of properties must be applicable to all of the shapes on their sheet. Students may need an index card or protractor to check right angles. They will also need a ruler to compare lengths and draw straight lines. Mirrors can be provided for the students to check for symmetry. If you don't have mirrors, the students can use pipe cleaners or toothpicks to place on top of the shapes to show lines of symmetry. Some students may also need to trace the shapes onto another piece of paper and cut it out to check for symmetry. They will then be able to fold the shape and manipulate it to decide if it is symmetrical. The words "at least" should highly be encouraged when the students are describing how many of something: for example, "rectangles have at least two lines of symmetry."

The groups will be asked to present their list to the rest of the class and justify any answers. If the answers are correct, the list should then be added to a class list. It is recommended that the presentations go in order beginning with parallelograms, rhombi, rectangle, and finally square. A class list (chart paper per polygon) will need to be posted in the room for the students to record their correct findings. As one group presents their list, the other students who worked on the same shapes.

Number Talk:

Even though this task involves a measurement standard, it is still important to practice number talks daily. There is an example of a number talk appropriate for 5^{th} grade below. However, feel free to choose or create a number talk that is relevant and/or needed for the students in your classroom.

Strategy: Proportional Reasoning

As students become stronger with their understanding of factors, multiples, and fractional reasoning, they may look at division from a proportional reasoning perspective. If students have had experiences with doubling and halving to solve multiplication problems, they will often wonder if the same approach will work with division. This is an excellent way to launch an investigation to lead to the idea that you can divide the dividend and divisor by the same amount to create a simpler problem. If the dividend and divisor share common factors, then the problem can be simplified. .

$\begin{array}{ccc} 384 & \div & 16 \\ \underline{\div\ 2} & & \underline{\div\ 2} \\ 192 & \div & 8 \end{array}$	Both 384 and 16 share the common factors of 2, 4, and 8. Let's simplify each number by dividing by 2.	$384 \div 16 = 24$ $192 \div 8 = 24$ $96 \div 4 = 24$ $48 \div 2 = 24$	We would have arrived at the correct answer of 24 with any of the problems.
$\begin{array}{ccc} 192 & \div & 8 \\ \underline{\div\ 2} & & \underline{\div\ 2} \\ 96 & \div & 4 \end{array}$ $\begin{array}{ccc} 96 & \div & 4 \\ \underline{\div\ 2} & & \underline{\div\ 2} \\ 48 & \div & 2 \end{array}$	As we divide each number by 2, the problem becomes 192/8. While this is a simpler problem than the original, we can still simplify each number by 2 since they are both even numbers. We can continue to divide by 2 to create an even smaller problem, or solve the problem whenever the numbers are easier to use.	$\frac{384}{16} = \frac{192}{8} = \frac{96}{4} = \frac{48}{2}$	It may be helpful to think of this sequence of division problems as equivalent fractions .

Below are two Proportional Reasoning Number Talks for you to try with your students.

$\frac{1000}{4}$	$\frac{720}{36}$
$\frac{200}{8}$	$\frac{360}{18}$
$\frac{400}{16}$	$\frac{60}{3}$

For additional Number Talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:

- Students should have the following background knowledge:
- Be able to use a straight edge or ruler to draw a straight line.
- Know how to use a protractor and ruler.
- Know how to identify right angles (90 degrees), obtuse angles, and acute angles (using a protractor or the corner of an index card).
- Understand that opposite sides can not touch each other; they are on opposite sides of the quadrilateral.
- Know parallel means that lines will never intersect or cross over each other no matter how long they are extended. (Students may prove that lines are parallel by laying down 2 straight objects, such as rulers, on the parallel sides of the quadrilateral, extending those sides. This will show how the line segments do not intersect even if they are extended.)
- Understand that perpendicular means lines or segments intersect or cross forming a right angle. (Some students may use a protractor, while others may use the corner of an index card or the corner of a sheet of paper to show an angle is a right angle.)
- Know that a property is an attribute of a shape that is always going to be true. It describes the shape.
- Be able to use a ruler to measure sides to verify they are the same length.
- Be able to use a mirror to check lines of symmetry
- Be able to use tracing paper to check for angle congruence

Some properties of quadrilaterals that should be discussed are included below. As students draw conclusions about the relationships between different figures, be sure they are able to explain their thinking and defend their conclusions.

- A shape is a quadrilateral when it has exactly 4 sides and is a polygon. (To be a polygon the figure must be a closed plane figure with three or more straight sides.)
- A square is always a rectangle because a square will always have 4 right angles like a rectangle.
- A rectangle does not have to have 4 equal sides like a square. It can have 4 right angles without 4 equal sides. Therefore, rectangle is not always a square.

- A square is always a rhombus because it has 4 equal sides like a rhombus and it is also a rectangle because it has 4 right angles like a rectangle.
- A rhombus does not have to have right angles like a square. It can have 4 equal sides without having 4 right angles. Therefore a rhombus is not always a square.
- A parallelogram can be a rectangle if it has 4 right angles.

Students think that when describing geometric shapes and placing them in subcategories, the last category is the only classification that can be used.

Formative Assessment Questions:

- How do you know this quadrilateral is a ________ (square, rectangle, parallelogram, trapezoid, or rhombus)?
- What is meant by the term "opposite sides"?
- What does "parallel" mean? How can you show that those sides parallel?
- What does "perpendicular" mean? How can you show that those sides are perpendicular?
- How can you show that 2 sides are equal?
- What are some ways we can show an angle is a right angle?

Differentiation:

Extension

- Ask students to create a Venn diagram which contains a comparison of the properties of two quadrilaterals.

Intervention

- Play Shape Sorts by Van De Walle, *Student Centered Mathematics* pg. 194

Vocabulary:

Quadrilateral	Right Angle	Contrast	Angle
Compare	Parallel	Perpendicular	

References:

Van de Walle, John A., Lou Ann H. Lovin. Teaching Student-Centered Mathematics: Grades 3-5, Volume 2. Pearson, 2006

Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Money For Chores

Content Standard

- **5.MD.3.** Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.*
- **5.MD.4.** Explain the classification of data from real-world problems shown in graphical representations including the use of terms mean and median with a given set of data. (L)
- **5.MD.5.** Recognize volume as an attribute of solid figures and understand concepts of volume measurement.
  a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume.
  b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units.

Mathematical Practices

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. Students draw pictures using dot cards, number lines, picture cards, and counters to represent and compare quantities or sets.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description

Students work to write expressions and solve equations

Materials:

- "How Many Ways?" student recording sheet
- Snap cubes

****Please visit link below for student recording sheet (pg. 66):**
Math Tasks- Grade 5-Unit-6
In this task, students will use 24 snap cubes to build cubes and rectangular prisms in order to generalize a formula for the volume of rectangular prisms.

Comments

To introduce this task ask students to make a cube and a rectangular prism using snap cubes. Discuss the attributes of cubes and rectangular prisms – faces, edges, and vertices. Initiate a conversation about the figures:

- What is the shape of the cube's base?
- What is the shape of the rectangular prism's base? The base of each is a rectangle (remember a square is a rectangle!).

Students should notice that the cube and rectangular prism are made up of repeated layers of the base. Describe the base of the figure as the first floor of a rectangular-prism-shaped building. Ask students, "What is the area of the base? Next, discuss the height of the figure. Ask students, "How many layers high is the cube?" or "How many layers high is the prism?" The number of layers will represent the height. DO NOT LEAD THE DISCUSSION TO THE VOLUME FORMULA. Students will use the results of this task to determine the volume formula for rectangular prisms on their own.

While working on the task, students do not need to fill in all ten rows of the "How Many Ways?" student recording sheet. Some students may recognize that there are only six different ways to create a rectangular prism using 24 snap cubes. For students who have found four or five ways to build a rectangular prism, tell them they have not found all of the possible ways **without telling them exactly how many ways are possible**. It is important for students to recognize when they have found all possible ways and to prove that they have found all of the possible rectangular prisms.

Once students have completed the task, lead a class discussion about the similarities and differences between the rectangular prisms they created using 24 snap cubes. Allow students to explain what they think about finding the volume of each prism they created. Also, allow students to share their conjectures about an efficient method to find the volume of any rectangular prism. Finally, as a class, come to a consensus regarding an efficient method for finding the volume of a rectangular prism.

Task Directions

Students will follow the directions below from the "How Many Ways?" student recording sheet.

1. Count out 24 cubes.
2. Build all the rectangular prisms that can be made with the 24 cubes.

For each rectangular prism, record the dimensions and volume in the table below.

3. What do you notice about the rectangular prisms you created?
4. How can you find the volume without building and counting the cubes?

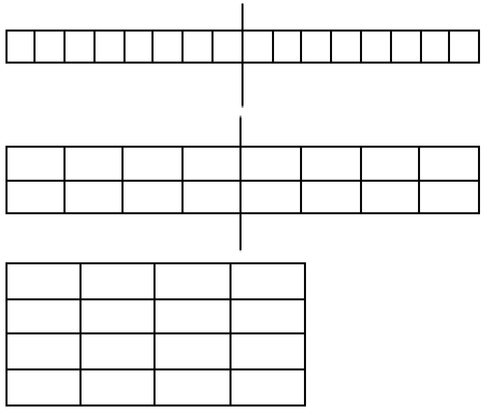
<u>Number Talk:</u>

Even though this task involves a measurement standard, it is still important to practice number talks daily. There is an example of a number talk appropriate for 5th grade below. However, feel free to choose or create a number talk that is relevant and/or needed for the students in your classroom.

Strategy: Doubling and Halving

When students are provided opportunities to build arrays that have the same area and study the patterns of the dimensions, they often will notice a relationship that occurs between the factors or dimensions of the arrays. Consider the number 16. If we were to build all the possible arrays that would make 16 squares, we would have the following dimensions or factor pairs: 1x16, 2x8, 4x4, 8x2, 16x1

In every instance, we still have an area or product of 16, but our dimensions or factors have changed.



When the 1x16 is halved, the number of rows doubles and the number of columns halve, resulting in 2 x 8.

When the 2x8 is halved, the number of rows doubles and the number of columns halve, resulting in a 4x4.

Doubling and halving can be continued until a 16x1 array is reached.

This strategy builds on the ease with which students double and halve numbers. We can apply this strategy to several problems.

8 x 25
/2 (   ) X2
4 x 50
/2 (   ) X2
2 x 100 = 200

The intent of the strategy is to change the problem into a friendly problem to solve. Once the student reaches a point where the solution is easily obtained, then he or she would not continue doubling and halving.

16 x 16
x2 (   ) /2
32 x 8
x2 (   ) /2
64 x 4
x2 (   ) /2
128 x 2 = 256

Doubling and halving is especially beneficial when multiplying with double digit problems. This can quickly turn the problem into a multiplication problem with a single-digit multiplier.

Note: some problems do not lend themselves to doubling and halving. This would be an important area for students to investigate.

Below are two Doubling and Halving Number Talks for you to try with your students.

360 X 3	112 X 2
180 X 6	56 X 4
90 X 12	28 X 8
45 X 24	14 X 16

For more additional number talks using this strategy please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:

Students should have had experiences with the attributes of rectangular prisms, such as faces, edges, and vertices, in fourth grade. This task will build upon this understanding. The "How Many Ways?" student recording sheet asks students to determine the area of the base of each prism using the measurements of base and height of the solid's BASE. The general formula for the area of a parallelogram is A = bh. Knowing the general formula for the area of a parallelogram enables students to memorize ONE formula for the area of rectangles, squares, and parallelograms since each of these shapes is a parallelogram. The general formula for the volume of a prism is V = Bh, where B is the area of the BASE of the prism and *h* is the height of the prism. Knowing the general formula for the volume of a prism prevents students from having to memorize different formulas for each of the types of prisms they encounter.

There are six possible rectangular prisms that can be made from 24 snap cubes.

$$1 \times 1 \times 24$$
$$1 \times 2 \times 12$$
$$1 \times 3 \times 8$$
$$1 \times 4 \times 6$$
$$2 \times 2 \times 6$$
$$2 \times 3 \times 4$$

Students may identify rectangular prisms with the same dimensions in a different order, for example, $1 \times 4 \times 6$, $1 \times 6 \times 4$, $6 \times 1 \times 4$, $6 \times 4 \times 1$, $4 \times 1 \times 6$, $4 \times 6 \times 1$. All of these are the same rectangular prism, just oriented differently. It is okay for students to include these different orientations on their recording sheet. However, some students may need to be encouraged to find different rectangular prisms.

Students may have difficulty with the concept of the formula V=Bh representing 3 factors. (length, width, height). They may leave out one of the components because of that misconception.

Formative Assessment Questions:

- What is the shape of the rectangular prism's base? Explain how to calculate the base of 3-dimensional objects.
- How did you determine the height of the rectangular prism? How do you know? (How many layers or "floors" does it have?)
- What is the volume of the rectangular prism? How do you know? (How many snap cubes did you use to make the rectangular prism? How do you know?)

Differentiation:

Extension

- Ask students to suggest possible dimensions for a rectangular prism that has a volume of 42 cm cubed without using snap cubes.
- Ask students to explore the similarities and differences of a rectangular prism with dimensions 3 cm x 4 cm x 5 cm and a rectangular prism with dimensions 5 cm x 3 cm x 4 cm. Students can consider the attributes and volumes of each of the prisms.
- Students can calculate the area of each surface of the solid and determine the total surface area.

Intervention

- Some students may need organizational support from a peer or by working in a small group with an adult. This person may help students recognize duplications in their table as well as help them recognize patterns that become evident in the table.
- Some students may benefit from using the "Cubes" applet on the Illuminations web site (visit link in "Technology Connection" below). It allows students to easily manipulate the size of the rectangular prism and then build the rectangular prism using unit cubes

Vocabulary:

Rectangular Prism
Cube
Formula
Surface Area
Volume
3-dimensional object

References:
Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010

Exploring With Boxes

Content Standard

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  c. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume.
  d. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units.

Mathematical Practices

1. Make sense of problems and persevere in solving them.
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5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure. Students will use tally marks to represent benchmarks (5, 10) of counting
8. Look for and express regularity in repeated reasoning.

Task Description

In this task, students will create boxes and discover how volume is related to the length, width, and height of cubes. (Adapted from *K-5 Math Teaching Resources)*

Materials:

- cube patterns
- scissors
- tape
- cm cubes
- ruler
- recording sheet

****Please visit link below for recording sheet (pg. 70):**
[MathTasks-Grade5-Unit6]

In this task, students will create boxes and discover how volume is related to the length, width, and height of cubes.

Comments:
To introduce this task, show the cube pattern and ask this question? What could be done to this pattern so that the top of the cube will be open? Students should be able to tell that the top square could be cut off. Tell students that they will be building open cubes of different sizes and filling them with cubes. Explain that they will need to measure the dimensions of each cube to complete the chart. Once students have completed the task, lead a class discussion about the patterns they noticed. Allow students to explain their findings and any relationships they noticed. Also, allow students to share their conclusions about the relationships between volume and the dimensions of cubes. Finally, allow students to write about their findings in their math journals.

Task Directions:
Using the open cube pattern, have students construct cubes of different dimensions and fill them with cm cubes. Have them measure the dimensions and record them in the appropriate boxes on the recording sheet. Then they will count the number of cubes it took to fill the cube and record the volume of each cube. Have students discuss their findings to generalize statements about the relationship between the dimensions of the cubes and their volume.

<u>Number Talk:</u>
Even though this task involves a measurement standard, it is still important to practice number talks daily. There is an example of a number talk appropriate for 5th grade below. However, feel free to choose or create a number talk that is relevant and/or needed for the students in your classroom.
Strategy: Keeping a Constant Difference (Subtraction):
As students begin to understand subtraction as the difference between two quantities, they can investigate what occurs if both numbers are changed by the same amount. Allowing students to explore this relationship with smaller problems such as 5-3 is a way to help them build this understanding. If 5 and 3 are both changed by +2, the problem 7-5 will result. Notice there is still a difference of 2. What if we removed 2 from each number in the problem 5-3? We would then create the problem 3-1, which still results in a difference of 2. Adding or subtracting the same quantity from both the subtrahend and minuend maintains the difference between the numbers. Manipulating the numbers in this way allows the student to create a friendlier problem without compromising the result. .

$$123 - 59$$

$$\begin{array}{rcr} 123 + 1 = & & 124 \\ \underline{-\ 59} + 1 = & & \underline{-\ 60} \\ 64 & & 64 \end{array}$$

Both numbers have been adjusted by +1, which makes a problem with an easy 10. Deciding on the amount to subtract or add to adjust the problem is a big decision. For instance, would it have been helpful to adjust each number by -1? This would have created the problem 122 – 58, which is not an easier problem to solve..

Below are two keeping a Constant Difference Number Talks for you to try with your students

$14 - 10$	$300 - 214$
$13 - 9$	$500 - 289$
$14 - 7$	$700 - 477$
$15 - 6$	$1000 - 674$

For additional number talks using this strategy, please visit *Number Talks* by Sherry Parrish.

Background Knowledge/Common Misconceptions:
Students should have experience with drawing boxes on grid paper. They also need to understand how to cut and fold the patterns to make boxes. Teachers may need to model and let students practice before the task. When filling a solid figure, there can be no gaps or overlaps with the cubes filling the object.

Formative Assessment Questions:

- What do you notice about the size of the open cubes and the number of cm cubes they can hold? Explain your thinking.
- Could you predict how many cm cubes a container can hold, based on its measurements? Justify your answer.

Differentiation:

Extension

- Students may create their own open cubes with grid paper.
- Students may present a demonstration on drawing cubes to the class.

Intervention

- Students may work with partners.
- Students may need support to measure dimensions accurately.
- Students may need support with differentiating between the length, width, and height on an open cube.

Vocabulary:

Volume

Cube

Length

Width

Height

References:

Parrish, Sherry. Number Talks: Helping Children Build Mental Math and Computation Strategies, Grades K 5. Sausalito: Math Solutions Publications, 2010