



# CCGPS Frameworks Teacher Edition

## Mathematics

### Fifth Grade Unit Three Multiplying and Dividing With Decimals



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*"Making Education Work for All Georgians"*

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## **Unit 3: Multiplying and Dividing with Decimals**

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## **OVERVIEW**

### **Perform operations with multi-digit whole numbers and with decimals to the hundredths.**

General methods used for computing products of whole numbers extend to products of decimals. Because the expectations for decimals are limited to thousandths and expectations for factors are limited to hundredths at this grade level, students will multiply tenths with tenths and tenths with hundredths, but they need not multiply hundredths with hundredths. Before students consider decimal multiplication more generally, they can study the effect of multiplying by 0.1 and by 0.01 to explain why the product is ten or a hundred times as small as the multiplicand (moves one or two places to the right). They can then extend their reasoning to multipliers that are single-digit multiples of 0.1 and 0.01 (e.g., 0.2 and 0.02, etc.).

There are several lines of reasoning students can use to explain the placement of the decimal point in other products of decimals. Students can think about the product of the smallest base-ten units of each factor. For example, a tenth times a tenth is a hundredth, so  $3.2 \times 7.1$  will have an entry in the hundredths place. Note, however, that students might place the decimal point incorrectly for  $3.2 \times 8.5$  unless they take into account the 0 in the ones place in the product of  $32 \times 85$ . (Or they can think of  $0.2 \times 0.5$  as 10 hundredths.) They can also think of decimals as fractions or as whole numbers divided by 10 or 100. When they place the decimal point in the product, they have to divide by a 10 from each factor or 100 from one factor. For example, to see that  $0.6 \times 0.8 = 0.48$ , students can use fractions:  $6/10 \times 8/10 = 48/100$ . Students can also reason that when they carry out the multiplication without the decimal point, they have multiplied each decimal factor by 10 or 100, so they will need to divide by those numbers in the end to get the correct answer. Also, students can use reasoning about the sizes of numbers to determine the placement of the decimal point. For example,  $3.2 \times 8.5$  should be close to  $3 \times 9$ , so 27.2 is a more reasonable product for  $3.2 \times 8.5$  than 2.72 or 272. This estimation based method is not reliable in all cases, however, especially in cases students will encounter in later grades. For example, it is not easy to decide where to place the decimal point in  $0.023 \times 0.0045$  based on estimation. Students can summarize the results of their reasoning such as those above as specific numerical patterns and then as one general overall pattern such as “the number of decimal places in the product is the sum of the number of decimal places in each factor.”

General methods used for computing quotients of whole numbers extend to decimals with the additional issue of placing the decimal point in the quotient. As with decimal multiplication, students can first examine the cases of dividing by 0.1 and 0.01 to see that the quotient becomes 10 times or 100 times as large as the dividend. For example, students can view  $7 \div 0.1 =$  as asking how many tenths are in 7. Because it takes 10 tenths to make 1, it takes 7 times as many tenths to make 7, so  $7 \div 0.1 = 7 \times 10 = 70$ . Or students could note that 7 is 70 tenths, so asking how many tenths are in 7 is the same as asking how many tenths are in 70 tenths, which is 70. In other words,  $7 \div 0.1$  is the same as  $70 \div 1$ . So dividing by 0.1 moves the number 7 one place to the left, the quotient is ten times as big as the dividend. As with decimal multiplication, students can then proceed to more general cases. For example, to calculate  $7 \div 0.2$ , students can reason that 0.2 is 2 tenths and 7 is 70 tenths, so asking how many 2 tenths are in 7 is the same as asking how many 2 tenths are in 70 tenths. In other words,  $7 \div 0.2$  is the same as  $70 \div 2$ ; multiplying both the 7 and the 0.2 by 10 results in the same quotient. Or students could calculate  $7 \div 0.2$  by viewing the 0.2 as  $2 \times 0.1$ , so they can first divide 7 by 2, which is 3.5, and then divide that result by 0.1, which makes 3.5 ten times as large, namely 35. Dividing by a decimal less than 1 results

in a quotient larger than the dividend and moves the digits of the dividend one place to the left. Students can summarize the results of their reasoning as specific numerical patterns then as one general overall pattern such as “when the decimal point in the divisor is moved to make a whole number, the decimal point in the dividend should be moved the same number of places.

Mathematically proficient students communicate precisely by engaging in discussion about their reasoning using appropriate mathematical language. The terms students should learn to use with increasing precision with these clusters are: **place value, patterns, multiplication/multiply, division/divide, decimal, decimal point, tenths, hundredths, products, quotients, dividends, rectangular arrays, area models, addition/add, subtraction/subtract, (properties)-rules about how numbers work, reasoning.**

**The Critical Areas are designed to bring focus to the standards at each grade by describing the big ideas that educators can use to build their curriculum and to guide instruction.**

**Extending division to 2-digit divisors, integrating decimal fractions into the place value system and developing understanding of operations with decimals to hundredths, and developing fluency with whole number and decimal operation.**

Students develop understanding of why division procedures work based on the meaning of base-ten numerals and properties of operations. They finalize fluency with multi-digit addition, subtraction, multiplication, and division. They apply their understandings of models for decimals, decimal notation, and properties of operations to add and subtract decimals to hundredths. They develop fluency in these computations, and make reasonable estimates of their results. Students use the relationship between decimals and fractions, as well as the relationship between finite decimals and whole numbers (i.e., a finite decimal multiplied by an appropriate power of 10 is a whole number), to understand and explain why the procedures for multiplying and dividing finite decimals make sense. They compute products and quotients of decimals to hundredths efficiently and accurately.

These tasks are not intended to be the sole source of instruction. They are representative of the kinds of experiences students will need in order to master the content, as well as mathematical practices that lead to conceptual understanding. Teachers need not do every task in the unit; they should choose the tasks that fit their students’ needs.

## **STANDARDS FOR MATHEMATICAL CONTENT**

**Understand the place value system.**

**MCC5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

**Perform operations with multi-digit whole numbers and with decimals to the hundredths.**

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

1. **Make sense of problems and persevere in solving them.** Students solve problems by applying and extending their understanding of multiplication and division to decimals. Students seek the meaning of a problem and look for efficient ways to solve it. They determine where to place the decimal point in calculations.
2. **Reason abstractly and quantitatively.** Students demonstrate abstract reasoning to connect decimal quantities to fractions, and to compare relative values of decimal numbers. Students round decimal numbers using place value concepts.
3. **Construct viable arguments and critique the reasoning of others.** Students construct arguments using concrete referents, such as objects, pictures, and drawings. They explain calculations and placement of the decimal point, based upon models and rules that generate patterns. They explain their thinking to others and respond to others' thinking.
4. **Model with mathematics.** Students use base ten blocks, drawings, number lines, and equations to represent decimal place value, multiplication and division. They determine which models are most efficient for solving problems.
5. **Use appropriate tools strategically.** Students select and use tools such as graph or grid paper, base ten blocks, and number lines to accurately solve multiplication and division problems with decimals.
6. **Attend to precision.** Students use clear and precise language, (math talk) in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to decimal place value and use decimal points correctly.
7. **Look for and make use of structure.** Students use properties of operations as strategies to multiply and divide with decimals. Students utilize patterns in place value and powers of ten to correctly place the decimal point.

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

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

### ENDURING UNDERSTANDINGS

- Students will understand that the placement of the decimal is determined by multiplying or dividing a number by 10 or a multiple of 10.
- Students will understand that multiplication and division are inverse operations of each other.
- Students will understand that rules for multiplication and division of whole numbers also apply to decimals.

### ESSENTIAL QUESTIONS

- How can we use exponents to represent powers of 10?
- How does multiplying or dividing by a power of ten affect the product?
- How can we use models to help us multiply and divide decimals?
- How do the rules of multiplying whole numbers relate to multiplying decimals?
- How are multiplication and division related?
- How are factors and multiples related to multiplication and division?
- What are some patterns that occur when multiplying and dividing by decimals?
- How can we efficiently solve multiplication and division problems with decimals?
- What strategies are effective for finding a missing factor or divisor?
- How can we check for errors in multiplication or division of decimals?

### CONCEPTS/SKILLS TO MAINTAIN

This standard requires students to extend the models and strategies they developed for whole numbers in grades 1-4 to decimal values. Before students are asked to give exact answers, they should estimate answers based on their understanding of operations and the value of the numbers.

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

- Number sense
- Whole number computation

## **SELECTED TERMS AND SYMBOLS**

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

**The terms below are for teacher reference only and are not to be memorized by students.**

Teachers should first present these concepts to students with models and real life examples. Students should understand the concepts involved and be able to recognize and/or use them with words, models, pictures, or numbers.

- **array**
- **associative property of multiplication**
- **commutative property of multiplication**
- **distributive property**
- **dividend**
- **division**
- **divisor**
- **factor**
- **hundred thousands**
- **hundreds**
- **hundredths**
- **identity property of multiplication**
- **measurement division (or repeated subtraction)**
- **millions**
- **multiple**
- **multiplier**
- **ones**
- **partial products**
- **partition/partitive division (or fair-sharing)**
- **place value**
- **product**
- **quotient**
- **remainder**
- **ten thousands**
- **tens**
- **tenths**
- **thousands**

## **COMMON CORE GLOSSARY**

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

## **STRATEGIES FOR TEACHING AND LEARNING**

As students developed efficient strategies to do whole number operations, they should also develop efficient strategies with decimal operations.

Students should learn to estimate decimal computations before they compute with pencil and paper. The focus on estimation should be on the meaning of the numbers and the operations, not on how many decimal places are involved. For example, to estimate the product of  $32.84 \times 4.6$ , the estimate would be more than 120, closer to 150. Students should consider that 32.84 is closer to 30 and 4.6 is closer to 5. The product of 30 and 5 is 150. Therefore, the product of  $32.84 \times 4.6$  should be close to 150.

Have students use estimation to find the product by using exactly the same digits in one of the factors with the decimal point in a different position each time. For example, have students estimate the product of  $275 \times 3.8$ ;  $27.5 \times 3.8$  and  $2.75 \times 3.8$ , and discuss why the estimates should or should not be the same.

In addition to strategies specific to content standards, students should also practice the following throughout the unit:

- Students should be actively engaged by developing their own understanding.
- Mathematics should be represented in as many ways as possible by using graphs, tables, pictures, symbols, and words.
- Appropriate manipulatives and technology should be used to enhance student learning.
- Students should be given opportunities to revise their work based on teacher feedback, peer feedback, and metacognition which includes self-assessment and reflection.
- Students need to write in mathematics class to explain their thinking, talk about how they perceive topics, and justify their work to others.

**Teachers need to provide instructional experiences so that students progress from the concrete level, to the pictorial level, then to the abstract level when learning mathematical concepts.**

## **EVIDENCE OF LEARNING**

Students should demonstrate a conceptual understanding of operations with decimals as opposed to a purely procedural knowledge. For example, students should understand that if they are multiplying tenths by tenths, the product must be expressed as hundredths. (i.e.,  $1/10 \times 1/10 = 1/100$ ). Students should also know to round to the nearest whole number and estimate to place the decimal, using the estimate to determine the reasonableness of an answer, rather than only knowing to count the digits after the decimal point to place the decimal point in the answer.

By the conclusion of this unit, students should be able to demonstrate the following competencies:

- understand place value
- use whole number exponents to denote powers of 10
- compare decimals
- model multiplication and division of decimals
- multiply and divide decimals by powers of 10



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- use estimation when multiplying and dividing decimals
- multiply and divide decimals with fluency
- determine relationship between quantities algebraically
- recognize student errors in multiplication and division of decimals
- use decimals to solve problems

**TASKS**

The following tasks represent the level of depth, rigor, and complexity expected of all fifth grade students. These tasks or tasks of similar depth and rigor should be used to demonstrate evidence of learning. It is important that all elements of a task be addressed throughout the learning process so that students understand what is expected of them. While some tasks are identified as performance tasks, they may also be used for teaching and learning (learning task).

<b>Scaffolding Task</b>	Tasks that build up to the learning task.
<b>Learning Task</b>	Constructing understanding through deep/rich contextualized problem solving tasks.
<b>Practice Task</b>	Tasks that provide students opportunities to practice skills and concepts.
<b>Performance Task</b>	Tasks which may be a formative or summative assessment that checks for student understanding/misunderstanding and or progress toward the standard/learning goals at different points during a unit of instruction.
<b>Culminating Task</b>	Designed to require students to use several concepts learned during the unit to answer a new or unique situation. Allows students to give evidence of their own understanding toward the mastery of the standard and requires them to extend their chain of mathematical reasoning.
<b>Formative Assessment Lesson (FAL)</b>	Lessons that support teachers in formative assessment which both reveal and develop students' understanding of key mathematical ideas and applications. These lessons enable teachers and students to monitor in more detail their progress towards the targets of the standards.
<b>CTE Classroom Tasks</b>	Designed to demonstrate how the Common Core and Career and Technical Education knowledge and skills can be integrated. The tasks provide teachers with realistic applications that combine mathematics and CTE content.

<b>Task Name</b>	<b>Task Type/Grouping Strategy</b>	<b>Content Addressed</b>	<b>Standard(s)</b>
Power-ful Exponents	Practice/Whole group, small group or individual	Whole number exponents	MCC5.NBT.2
What Comes Next?	Constructing/Whole group, small group	Multiplying or dividing by powers of ten	MCC5.MBT.2

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Patterns-R-U's	Scaffolding-Constructing/Small group	Multiplying or dividing by powers of ten	MCC5.NBT.2 MCC5.NBT.7
Base Ten Activity	Scaffolding-Constructing/Small group or pair	Modeling the multiplication of decimals	MCC5.NBT.7
Missing Numbers	Constructing/Small group or individual	Multiplying decimals	MCC5.NBT.7
Multiplication Teasers	Constructing/Small group or individual	Multiplying decimals	MCC5.NBT.7
How Much Money?	Constructing/Individual or pair	Dividing decimals	MCC5.NBT.7
Place the Point	Constructing/Small group or individual	Dividing decimals	MCC5.NBT.2 MCC5.NBT.7
Super Slugger Award	Practice/Individual or pair	Dividing decimals	MCC5.NBT.7
Number Puzzles	Practice/Individual or pair	Multiplying & dividing decimals	MCC5.NBT.7
What's My Rule?	Practice/Whole group or small group	Multiplying & dividing decimals	MCC5.NBT.7
Do You See an Error?	Practice/Individual or pair	Multiplying & dividing decimals	MCC5.NBT.7
Road Trip	Practice/Individual or pair	Multiplying & dividing decimals	MCC5.NBT.7
Multiplying and Dividing Decimals	Formative Assessment Lesson (FAL)	Multiplying & dividing decimals	MCC.5.NBT.7
Teacher for a Day	Performance/Individual	Multiplying & dividing decimals	MCC5.NBT.2 MCC5.NBT.7
Bargain Shopping	Performance/Individual	Multiplying & dividing decimals	MCC5.NBT.2 MCC5.NBT.7
Field Trip	Culminating/Individual	Multiplying & dividing decimals	MCC5.NBT.2 MCC5.NBT.7

**If you need further information about this unit visit the GaDOE website and reference the unit webinars.**

<https://www.georgiastandards.org/Common-Core/Pages/Math-PL-Sessions.aspx>



### **Practice Task: Power-ful Exponents**

*Adapted from [www.nzmaths.co.nz/resource/beyond-million-amazing-math-journey](http://www.nzmaths.co.nz/resource/beyond-million-amazing-math-journey)*

In this activity, students will develop an understanding that place value can be expressed as a power of 10 (exponents). They will also explore multiplication as a very powerful operation that can create very large numbers (exponential multiplication).

## **STANDARDS FOR MATHEMATICAL CONTENT**

### ***Understand the place value system.***

- **MCC5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

## **STANDARDS FOR MATHEMATICAL PRACTICE**

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

## **BACKGROUND KNOWLEDGE**

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.

## **COMMON MISCONCEPTIONS**

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

## **ESSENTIAL QUESTIONS**

- How are exponents used to represent powers of 10?

## **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

### **GROUPING**

Whole/individual/small group task

### **TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION**

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.

### **TASK**

#### ***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.

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- 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.

**FORMATIVE ASSESSMENT QUESTIONS**

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

**DIFFERENTIATION:**

**Extension**

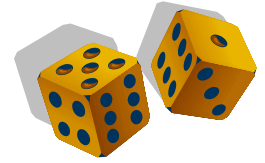
- Students can explore writing large numbers in scientific notation.
- Students can research large numbers and the meaning of their names.

**Intervention**

- Most students, including students needing an intervention here, would benefit from the use of base ten materials. For example,  $10^2$  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,  $10^5$  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.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Powers of 10 Yahtzee



**Materials:** 1 die (6-sided); Recording Sheet

**Number of Players:** 2 or more

**Directions:**

- Take turns rolling the die until each has rolled 5 times. Each time you roll the die you are rolling a power of 10. The base number is always 10.
- 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.
- Continue taking turns until each of you has had 5 turns. 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.

**Game 1:**

<u>Player 1</u>		<u>Player 2</u>	
<u>Exponential Expression</u>	<u>Value</u>	<u>Exponential Expression</u>	<u>Value</u>

Player 1's Sum: \_\_\_\_\_

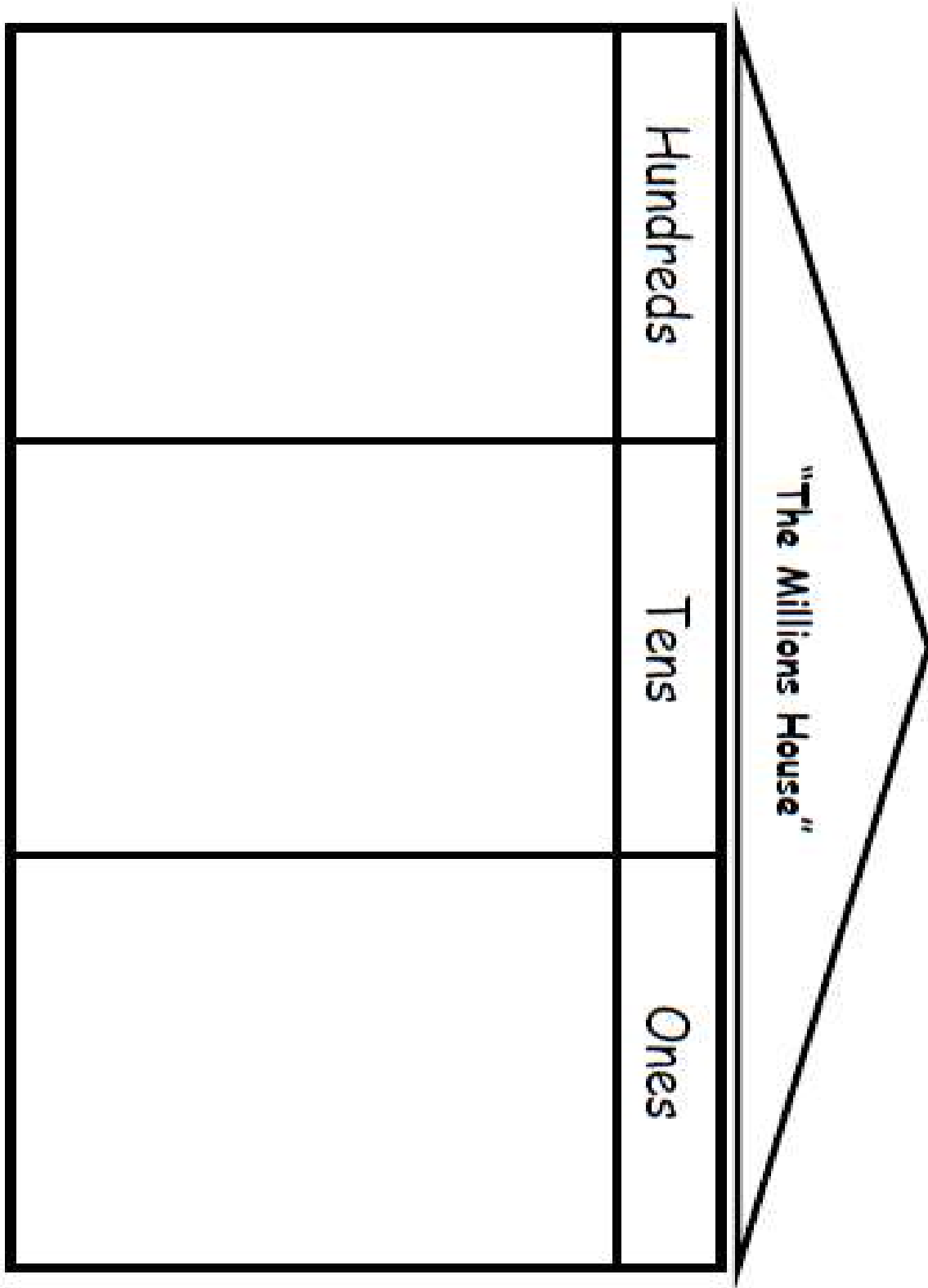
Player 2's Sum: \_\_\_\_\_

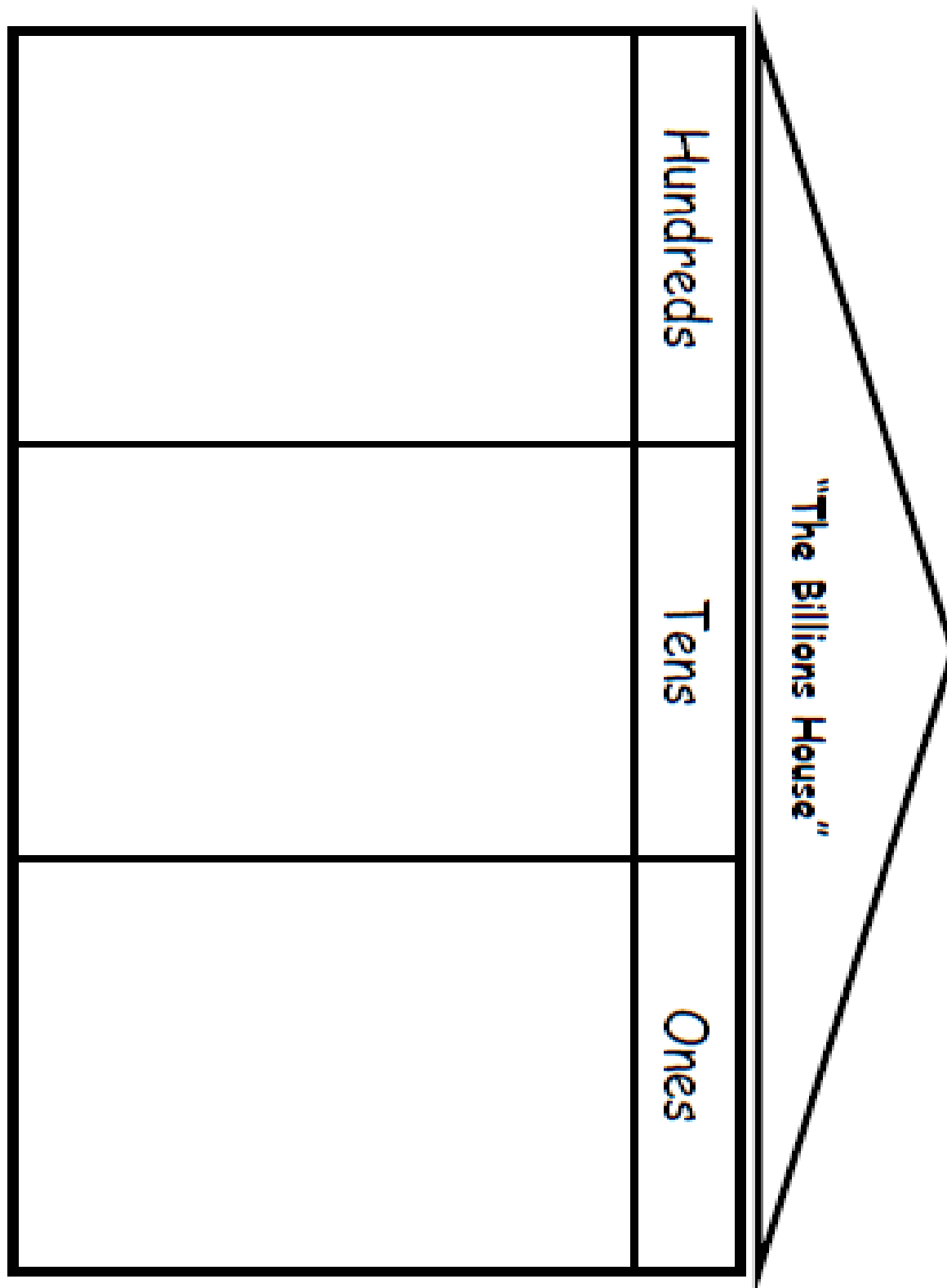
**Game 2:**

<u>Player 1</u>		<u>Player 2</u>	
<u>Exponential Expression</u>	<u>Value</u>	<u>Exponential Expression</u>	<u>Value</u>

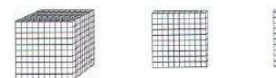
Player 1's Sum: \_\_\_\_\_

Player 2's Sum: \_\_\_\_\_









## **Constructing Task: What Comes Next?**

*Adapted from “What Comes Next?” in Van de Walle’s Teaching Student-Centered Mathematics*

In this task, students explore the pattern of powers of 10 with base ten blocks.

### **STANDARDS FOR MATHEMATICAL CONTENT**

*Understand the place value system.*

**MCC5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

Two important ideas typically developed for three-digit numbers should be carefully extended to larger numbers. First, the grouping of ten ideas should be generalized. That is, 10 in any position make a single thing (group) in the next position, and vice versa. Second, the oral and written patterns for numbers in three digits are duplicated in a clever way for every three digits to the left. These two related ideas are not as easy for children to understand as adults seem to believe. Because models for larger numbers are so difficult to have or picture, textbooks must deal with these ideas in a predominately symbolic manner. That is not sufficient! Try the “What Comes Next?” discussion in the context of three-dimensional models through the use of base ten manipulatives. The first three shapes are distinct: a *cube*, a *long*, and a *flat*. What comes next? Stack 10 flats and they make a cube, the same shape as the first only 1000 times larger. What comes next? Ten *cubes* make another *long*. What comes next? Ten big *longs* make a big *flat*. The first three shapes have now repeated! Ten big flats will make an even bigger cube, and the triplet of shapes begins again. Each cube has a name. The first one is the *unit* cube, the next is a *thousand*, the next is a *million*, then a *billion*, and so on. Each long is 10 cubes: 10 units, 10 thousands, 10 millions. Similarly, each flat shape is 100 cubes. It is important for students to realize that the system does have a logical structure, is not totally arbitrary, and can be understood (Van de Walle, 2006). **Students will be using base ten strips and squares for this task which makes the modes two-dimensional versus three-dimensional. Because of this,**

**the sequence will be square, strip, square, strip, etc. instead. A part of the problem-based task is to determine and continue this pattern.**

A difficult idea for students to comprehend is why any base number raised to the zero power has a value of one. Consider this example:  $3^1 = 3$ ,  $3^2 = 9$ ,  $3^3 = 27$ ,  $3^4 = 81$ ... Look at the pattern of the bold numbers. Every time you move to the right in the list, you multiply by 3. If you move to the left, you divide by 3. If we continued the sequence one more to the left you would have  $3^0 = 1$ . Examples such as this one can be explored with students to help clarify this concept.

### **COMMON MISCONCEPTIONS**

- *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 *groups of* interchangeably can assist with the contextual understanding.
- *Is  $a \times a \times a = 3a$ ? Is  $a^3 = a \times 3$ ?* In mathematics each symbol has a uniquely defined meaning.  $a \times 3$  has been arbitrarily chosen as shorthand for  $a + a + a$ . It cannot mean anything else.  $a^3$  has been, equally arbitrarily, chosen as shorthand for  $a \times a \times a$ . It means precisely this. Always consider the unique meanings of the mathematics you write.

### **ESSENTIAL QUESTIONS**

- How can we use exponents to represent powers of 10?

### **MATERIALS**

- “What Comes Next?” recording sheet
- Base ten blocks
- Base ten strips and squares
- Butcher paper
- Markers
- Calculators (optional)

### **GROUPING**

Whole group/small group task

**TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

Comments: This task is designed to serve as a discovery opportunity for the students. Students should notice that a pattern is created when a number is multiplied or divided by a power of 10. While students may notice patterns in each individual part of the task, encourage them to look for a pattern when considering the overall task. Students should be able to explain and defend their solutions through multiple representations. Calculators can be used to assist students with their explanations. For example, students may want to calculate that  $10 \times 10 \times 10 = 1000$  with this tool rather than using a written method.

**TASK**

**Part 1**

- Hand out base ten blocks to each group. Ask each group to hold up the unit cube. Ask students to prove how many units they think it represents. Write  $10^0$  on the board and share that this is another way to represent the value of the unit cube. Discuss that mathematicians have agreed that no matter what the base number is, if it is raised to the zero power, its value is always one unit. (See Background Knowledge to support discussion with students)
- Have each group hold up a tens rod and ask them to justify how many units it represents. Write  $10^1$  on the board and share that this is another way to represent the value of the block. Have the students discuss why they think this could be another way to represent the value of 10. (There is one group of ten or one group of ten units)
- Have each group hold up a hundreds flat and ask them to justify how many units it represents. Write  $10^2$  on the board and ask why this could be another way to represent 100 units. (You can multiply  $10 \times 10$  to get one hundred or you are multiplying ten by itself two times) *Optional:* Ask students why they think we call a base number that is raised to the second power, “squared”. (Because it is shaped like a square)
- Have each group hold up a thousands cube and ask them to justify how many units it represents. Ask the students to predict how to write this number with exponents and justify their conjectures. (You can multiply  $10 \times 10 \times 10$  to get one thousand or you are multiplying ten by itself three times) *Optional:* Ask students why they think we call a base number that is raised to the third power, “cubed”. (Because it is shaped like a cube)

**Part 2**

- Use the “What Comes Next?” recording sheet to lead a discussion using the base ten strips and squares. Discuss that the unit is a 1-centimeter square. Ten units are represented using a  $10 \times 1$  strip. The hundreds piece is a  $10 \times 10$  square. Ask students what would come next. Allow time for groups to discuss their ideas. Ten hundreds would be a thousand, but what shape would it be? It could be a strip made by ten hundreds squares. Tape 10 hundreds together.
- After students have discovered how to represent the thousands piece, ask students what comes next. Allow groups the time to figure out the dimensions of the ten thousands piece and the hundred thousands piece.
- Students will fill out the “What Comes Next?” recording sheet as they progress through the task. Because of the discussion in part one, students will also be asked to note the whole number exponent that would be associated with each large number.

### **FORMATIVE ASSESSMENT QUESTIONS**

- How do you know your answer is correct?
- What patterns are you noticing?
- Can you predict what would come next in the pattern?

### **DIFFERENTIATION**

#### **Extension**

Students may become interested in seeing the big pieces from the discussion. Have them draw the representations on butcher paper or using chalk on the blacktop. Create a pictorial representation of ten thousand and hundred thousand.

#### **Intervention**

If students are having difficulty transferring to the base ten strips, have them work in small groups with the base ten blocks instead.

Name \_\_\_\_\_ Date \_\_\_\_\_



## What Comes Next?

1. Unit
  - a. What is the numerical value? \_\_\_\_\_
  - b. What shape is it? \_\_\_\_\_
  - c. What are the dimensions? \_\_\_\_\_
  - d. How would this be written using exponents? \_\_\_\_\_
2. Ten
  - a. What is the numerical value? \_\_\_\_\_
  - b. What shape is it? \_\_\_\_\_
  - c. What are the dimensions? \_\_\_\_\_
  - d. How would this be written using exponents? \_\_\_\_\_
3. Hundred
  - a. What is the numerical value? \_\_\_\_\_
  - b. What shape is it? \_\_\_\_\_
  - c. What are the dimensions? \_\_\_\_\_
  - d. How would this be written using exponents? \_\_\_\_\_
4. Thousand
  - a. What is the numerical value? \_\_\_\_\_
  - b. What shape is it? \_\_\_\_\_
  - c. What are the dimensions? \_\_\_\_\_
  - d. How would this be written using exponents? \_\_\_\_\_
5. Ten thousand
  - a. What is the numerical value? \_\_\_\_\_
  - b. What shape is it? \_\_\_\_\_
  - c. What are the dimensions? \_\_\_\_\_
  - d. How would this be written using exponents? \_\_\_\_\_
6. Hundred thousand
  - a. What is the numerical value? \_\_\_\_\_
  - b. What shape is it? \_\_\_\_\_
  - c. What are the dimensions? \_\_\_\_\_
  - d. How would this be written using exponents? \_\_\_\_\_

7. Do you notice a pattern in the sequence of shapes? If so, explain.

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8. Describe the relationship between the exponent and the number of zeros in the numbers above.

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9. Create a rule for using exponents with powers of ten.

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## **Scaffolding/Constructing Task: Patterns-R-U**

In this task, students are asked to identify, describe, and explain any patterns they notice when multiplying or dividing numbers by 1000, 100, 10, 0.1, and 0.01.

### **STANDARDS FOR MATHEMATICAL CONTENT**

#### ***Understand the place value system.***

**MCC5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

#### ***Perform operations with multi-digit whole numbers and with decimals to the hundredths.***

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

Students should develop an understanding that when a number is multiplied by a number less than 1, the product is less than the original number, and when a number is divided by a decimal number less than 1, the quotient will be greater than the dividend. This is important, yet often difficult for students to understand because it is counterintuitive based on students' previous experiences with multiplication and division.

Because students have not yet learned how to multiply or divide decimals, calculators are recommended for this investigation. Students will be more likely to explore a variety of numbers and be able to recognize patterns more efficiently with the use of a calculator. Require students to record what they put into the calculator and the result. If students have learned how to multiply and divide with decimals, they could benefit from solving the problems in part one without a calculator and allow students to use a calculator for the rest of the task.

### **COMMON MISCONCEPTIONS**

- *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 *groups of* interchangeably can assist with the contextual understanding.

### **ESSENTIAL QUESTIONS**

- How does multiplying or dividing by a power of ten affect the product?

### **MATERIALS**

- “Patterns-R-Us” recording sheet
- Calculators

### **GROUPING**

Small group task

### **TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION**

Comments: This task is designed to serve as a discovery opportunity for the students. Students should notice that a pattern is created when a number is multiplied or divided by a power of 10. While students may notice patterns in each individual part of the task, encourage them to look for a pattern when considering the overall task. Students should be able to explain and defend their solutions through multiple representations. For example, students should try several numbers for each part to verify that each number follows the same pattern. This activity lends itself to working in pairs for reinforcement.

An introduction for this task could be a round of “What’s My Rule?” The rule could be  $\times 1000$ ,  $\times 100$ ,  $\times 10$ ,  $\times 0.1$ , or  $\times 0.01$ . Also, the rule could be  $\div 1000$ ,  $\div 100$ ,  $\div 10$ ,  $\div 0.1$ , or  $\div 0.01$ .

### **TASK**

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

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

#### **Part 1**

1. Start with any whole number, for example 18.
2. Multiply that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000? 0.00001?



**Part 2**

1. Pick any decimal as your number, for example 12.3.
2. Multiply that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000? 0.00001?

**Part 3**

1. Start with any whole number, for example 18.
2. Divide that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you divided your number by 1,000,000? 0.00001?

**Part 4**

1. Pick any decimal as your number, for example 10.8.
2. Predict what will happen when you divide that number by 1000, 100, 10, 0.1, and 0.01.
3. After working out the problem, is your prediction correct? Why or why not?
4. Is there a similar pattern that you recognize?

**FORMATIVE ASSESSMENT QUESTIONS**

- How do you know your answer is correct?
- What would happen if you started with a different number?
- What patterns are you noticing?
- Can you predict what would come next in the pattern?

**DIFFERENTIATION**

**Extension**

- Have students multiply a number by 0.1. Now ask them to divide that same number by 10. What happened? Repeat this with several numbers. Can a conjecture be made based on the results? Have students write their conjecture. Now, share their conjecture with a partner. Are the two conjectures the same? (You may also use 0.01 and 100 as another example.)

**Intervention**

- Pair students who may need additional time so that they will have time needed to process this task.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Patterns-R-Us

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



### PART ONE

1. Start with any whole number, for example 18.
2. Multiply that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000? 0.00001?

### PART TWO

1. Pick any decimal as your number, for example 12.3.
2. Multiply that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you multiplied your number by 1,000,000? 0.00001?

### PART THREE

1. Start with any whole number, for example 18.
2. Divide that number by 1000, 100, 10, 0.1, and 0.01.
3. What is happening?
4. Is there a pattern?
5. What do you think would happen if you divided your number by 1,000,000? 0.00001?

### PART FOUR

1. Pick any decimal as your number, for example 10.8.
2. Predict what will happen when you divide that number by 1000, 100, 10, 0.1, and 0.01.
3. After working out the problem, is your prediction correct? Why or why not?
4. Is there a similar pattern that you recognize?



## **Scaffolding/Constructing Task: Base Ten Activity**

This task was adapted from the following website <http://argyll.epsb.ca/jreed/math7/strand1/1201.htm>

In this task, students will create rectangular arrays as a representation of multiplication and division of decimals.

### **STANDARDS FOR MATHEMATICAL CONTENT**

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.




### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

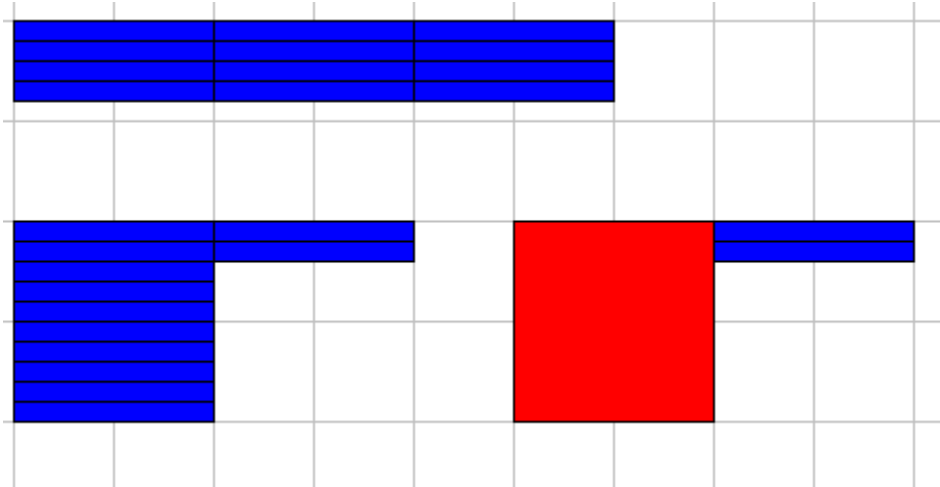
#### Representing decimal values with base ten blocks

In this activity you will use base ten blocks to represent decimals. In this case, the red block (flat) represents 1 unit, the blue (long or rod) represents one tenth of the unit or 0.1 units, and the green (unit) represents one hundredth or 0.01 units. You can use this system to introduce decimal numbers and the place value with decimal numbers. Also, students can explore addition and subtraction of decimals using base-ten blocks in a manner similar to adding and subtracting whole numbers using base ten blocks.

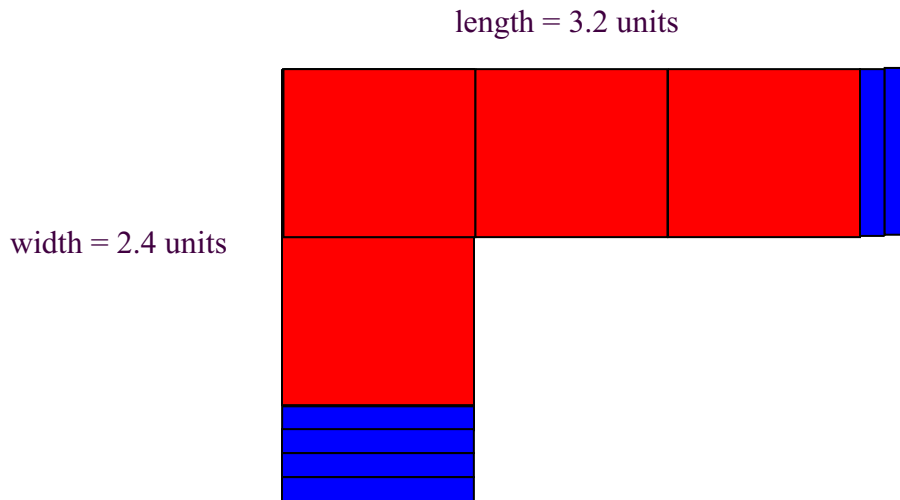
<b>Decimal Block Values</b>		
1 (flat)	0.1 (long)	0.01 (unit)
		

Representing decimal multiplication with base ten blocks

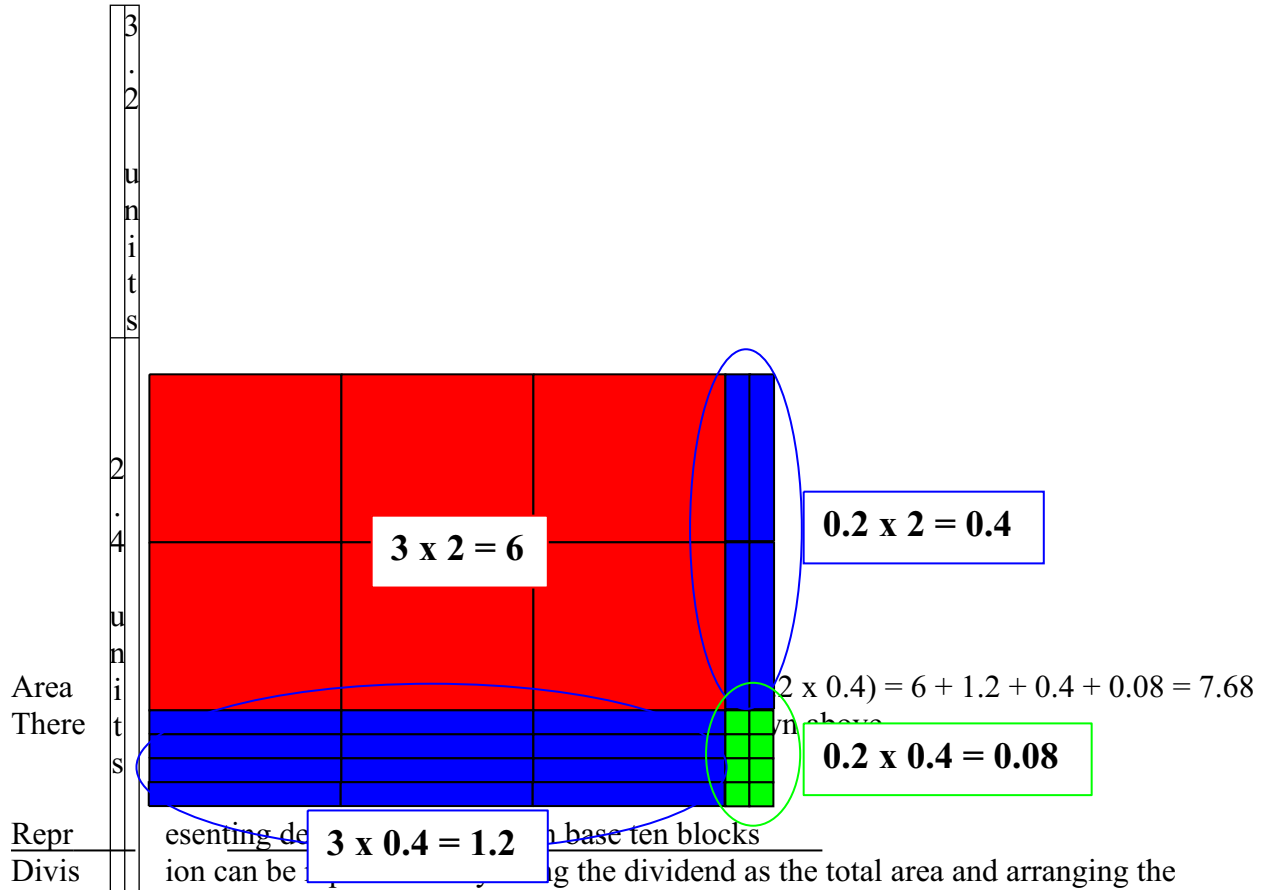
Decimal multiplication can be represented as an array or as repeated addition. For example, to multiply  $3 \times 0.4$  you pull out 3 sets of 0.4, represented by 3 sets of 4 longs. Arrange them in a 3 by 0.4 array as shown below. There are a total of 12 longs. 10 longs can be traded for a flat, with 2 longs left over. Or you can think of 12 tenths as being one whole and 2 tenths, therefore,  $3 \times 0.4 = 1.2$ .



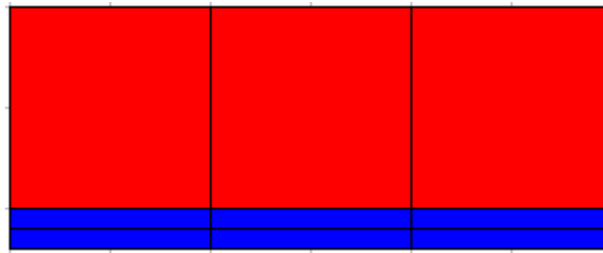
To illustrate the product of  $3.2 \times 2.4$  you will need to combine blocks in a rectangular array. Start with the length and the width.



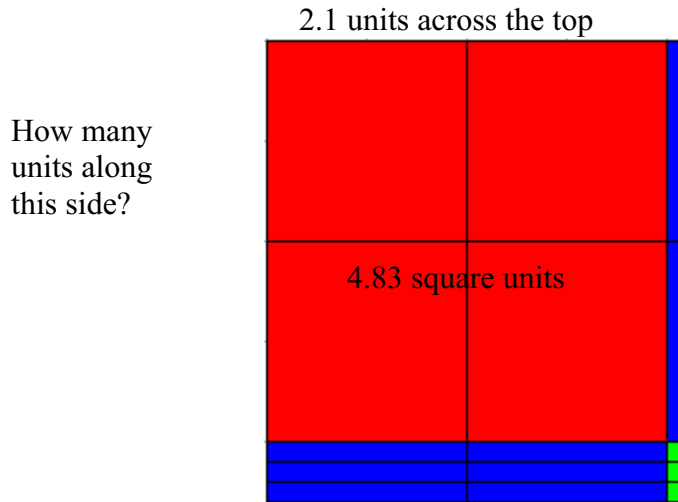
Then complete the rectangle.



representing the divisor as the total area and arranging the blocks in groups according to the divisor. The divisor would be built in columns, and columns would continue to be added until there are enough columns built so that the dividend is represented by the total area. The number of rows or groups created is the quotient. For the fifth problem,  $3.6 \div 1.2$ , ask the students how many groups of 1 flat and 2 longs can be made with a group of 3 flats and 6 longs. The quotient can be thought of as the missing factor in a multiplication problem.



In the example below ( $4.83 \div 2.1$ ), we are dividing a total of 4.83 blocks into equal groups of 2.1. In this example, the divisor is represented in rows. The quotient or number of groups is represented in columns, and it is 2.3. One dimension of this array is the divisor, or 2.1 given in the problem. The other dimension is 2.3 which is the quotient. It can also be thought of as the missing factor in a multiplication array.



### **COMMON MISCONCEPTIONS**

- *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 *groups of* interchangeably can assist with the contextual understanding.

### **ESSENTIAL QUESTIONS**

- How can we use models to help us multiply and divide decimals?

### **MATERIALS**

- Base-ten recording sheet
- Base-ten blocks (or virtual base-ten blocks)
- Grid paper (or plain paper) to record work
- Colored pencils, crayons, or markers

### **GROUPING**

Small group/Partner task




### **TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

Comments: When making rectangles to represent decimal multiplication, you are actually using the length and the width of each block to represent the factors. Therefore, a flat is actually 1 unit by 1 unit, a long is 1 unit by 0.1 unit, and a unit block is 0.1 unit by 0.1 unit. (area model)

**Task:**

Students will follow the directions below from the “Base 10 Activity” Recording Sheet.

Your task is to use the base-ten blocks to represent multiplication and division with decimals. Use the decimal block values below to help you find the product or quotient of each decimal problem.

<b>Decimal Block Values</b>		
1 (flat)	0.1 (long)	0.01 (unit)
		

1.  
4.8

- times 3
2.  $2.1 \times 5.4$
  3.  $0.6 \times 1.9$
  4.  $12 \div 0.3$
  5. 3.6 divided by 1.2

**FORMATIVE ASSESSMENT QUESTIONS**

- If the flat is 1 unit, what does a long represent? What does a unit block represent?
- How many groups do you need to represent? How many do you have in all?
- How can you create any array using multiplication? Where are the factors located? Where is the product? Can you identify the partial products?
- What properties of multiplication are you using?
- How can you create an array using the dividend? How do you represent the divisor in the array? Where is the quotient represented?

**DIFFERENTIATION**

**Extension**

- Have students create their own practice problems with solutions and then switch them with a partner. Have the partner work the problems using the base-ten blocks. When finished, students can compare solutions.

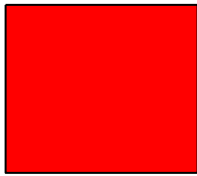


**Intervention**

- Have students work with a partner or with a teacher in small groups to help develop these concepts. Scaffold student understanding by initially providing arrays for students to use to find the product or quotient. Then provide a partially completed array or the outline of an array. Slowly remove scaffolding as students become more independent with finding a product or quotient using the base ten blocks.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Base Ten Activity

Your task is to use the base-ten blocks to represent multiplication and division with decimals. Use the decimal block values below to help you find the product or quotient of each decimal problem.

Decimal Block Values		
1 (flat)	0.1 (long)	0.01 (unit)
		

1.  
4.8

- times 3
2.  $2.1 \times 5.4$
  3.  $0.6 \times 1.9$
  4.  $12 \div 0.3$
  5. 3.6 divided by 1.2





## Constructing Task: Missing Numbers

In this task, students are challenged to find all the possibilities for missing numbers in a decimal multiplication number sentence.

### STANDARDS FOR MATHEMATICAL CONTENT

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### STANDARDS FOR MATHEMATICAL PRACTICE

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

### BACKGROUND KNOWLEDGE

If students use their prior knowledge about whole number multiplication, they will realize that the products will have the exact same digits, but the decimal placement will change the value of the numbers. If students are methodical about their solution strategy, they will be able to find all of the possibilities systematically from  $0.1 \times 5 = 0.5$  to  $1.9 \times 5 = 9.5$ .

### COMMON MISCONCEPTIONS

- *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 *groups of* interchangeably can assist with the contextual understanding.

### ESSENTIAL QUESTIONS

- How can we efficiently solve multiplication and division problems with decimals?
- How can we multiply and divide decimals fluently?
- What strategies are effective for finding a missing factor or divisor?

**MATERIALS**

- Calculators (optional)

**GROUPING**

Small group/Individual task

**TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

Comments: This task will allow the teacher to see if students are able to use what they know about whole number multiplication and transfer it to decimal multiplication. Students will be able to come up with more solutions if they realize that whole numbers can be represented with decimals. There is no recording sheet provided with this task. Instead, encourage students to document their thinking in their math journals or notebooks.

**TASK:**

$$\underline{\hspace{1cm}}.\underline{\hspace{1cm}} \times 5 = \underline{\hspace{1cm}}.\underline{\hspace{1cm}}$$

*What might the missing numbers be? Try to find all the possibilities.*

**FORMATIVE ASSESSMENT QUESTIONS**

- How did you get your answer?
- How do you know your answer is correct?
- What patterns are you noticing?

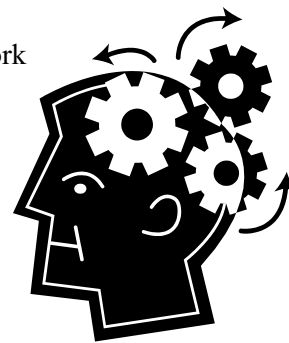
**DIFFERENTIATION**

**Extension**

- Students can explore problems like this with two factors that are decimal numbers.

**Intervention**

- Provide students with some whole number examples before incorporating decimals. Include some examples that only have one solution before moving to multiple solutions. Also, calculators can be used for this task.



## **Constructing Task: Multiplication Teasers**

*Adapted from Marilyn Burns' lesson "Multiplication Puzzlers" in About Teaching Mathematics*

In this task, students will be challenged to find the missing factor in a multiplication number sentence by first using estimation strategies, then refining their guesses by using a calculator.

### **STANDARDS FOR MATHEMATICAL CONTENT**

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

Students often do not understand that if a whole number is multiplied by a decimal, the product will be less than the larger factor. This task can provide students with problems that will make this evident.

### **COMMON MISCONCEPTIONS**

- *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.

**ESSENTIAL QUESTIONS**

- How can we efficiently solve multiplication and division problems with decimals?
- How can we multiply and divide decimals fluently?
- What strategies are effective for finding a missing factor or divisor?
- How can we use estimation to assist in solving problems with decimal operations?

**MATERIALS**

- “Multiplication Teasers” recording sheet
- Calculators (optional)

**GROUPING**

Small group/Individual task

**TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

Comments: A great deal of emphasis has been put on paper-and-pencil algorithms when solving problems with decimals. The focus is often put on how to do the problem rather than on what makes sense. Students should be given many opportunities to calculate decimals mentally. The emphasis shifts from getting exact answers from paper-and-pencil calculations to arriving at estimates and being able to explain why they are reasonable.

**TASK**

For each problem, find the missing factor. Do not solve problems by dividing. Instead, use your calculator and the guess and check problem solving strategy. See how many guesses it takes for you to solve each one! For example, to solve  $4 \times \underline{\hspace{1cm}} = 87$ , you might start with 23 and then adjust. See the solution steps below as an example of how to record your guesses.

$$\begin{aligned} 4 \times \underline{\hspace{1cm}} &= 87 \\ 4 \times 23 &= 92 \\ 4 \times 22 &= 88 \\ 4 \times 21 &= 84 \\ 4 \times 21.5 &= 86 \\ 4 \times 21.6 &= 86.4 \\ 4 \times 21.7 &= 86.8 \\ 4 \times 21.8 &= 87.2 \\ 4 \times 21.74 &= 86.96 \\ 4 \times 21.75 &= 87 \quad \star \end{aligned}$$

It took 9 guesses!

Try the following:

$8 \times \underline{\quad\quad} = 108$	$6 \times \underline{\quad\quad} = 99$
$4 \times \underline{\quad\quad} = 97$	$5 \times \underline{\quad\quad} = 66$

### **FORMATIVE ASSESSMENT QUESTIONS**

- How did you get your answer?
- How do you know your answer is correct?
- What patterns are you noticing?

### **DIFFERENTIATION**

#### **Extension**

- Provide students with problems that incorporate factors to the thousands and repeating decimals to challenge their thinking.

#### **Intervention**

- Work with small groups of struggling students to model the problem solving process by doing a think-aloud to work through an example problem.
- Incorporate the use of manipulatives (grid paper, base ten blocks, etc.) to assist with student guesses.



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## Multiplication Teasers

For each problem, find the missing factor. Do not solve problems by dividing. Instead, use your calculator and the guess and check problem solving strategy. See how many guesses it takes for you to solve each one! For example, to solve  $4 \times \underline{\quad} = 87$ , you might start with 23 and then adjust. See the solution steps below as example of how to record your guesses.

$$4 \times \underline{\quad} = 87$$

$$4 \times 23 = 92$$

$$4 \times 22 = 88$$

$$4 \times 21 = 84$$

$$4 \times 21.5 = 86$$

$$4 \times 21.6 = 86.4$$

$$4 \times 21.7 = 86.8$$

$$4 \times 21.8 = 87.2$$

$$4 \times 21.74 = 86.96$$

$$4 \times 21.75 = 87 \quad \star$$

It took 9 guesses!

Try the following:

$8 \times \underline{\quad} = 108$	$6 \times \underline{\quad} = 99$
$4 \times \underline{\quad} = 97$	$5 \times \underline{\quad} = 66$



## Constructing Task: How Much Money?

In this task, students will use division or other basic operations to find the number of coins equal to a given dollar value.

### STANDARDS FOR MATHEMATICAL CONTENT

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### STANDARDS FOR MATHEMATICAL PRACTICE

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

### BACKGROUND KNOWLEDGE

We want students to understand that when they are trying to determine the number of coins of specific values, they are indeed performing division (measurement division). Then, when they are solving  $34.50$  divided by  $0.25$ , one way to do this is to think of everything in terms of cents and determine how many groups of 25 cents can be made with 3450 cents. In this process, we changed both decimal numbers into whole numbers. Dividing to find the number of dimes might lead to an idea with efficiency. For example, instead of thinking about 3450 divided by 10, students can find the same answer by dividing 345.0 by 1.0.

NOTE: The purpose of the task is to give students practice in decimal division. They may be able to use reasoning such as “4 quarters in a dollar” so I can multiply dollars by 4 to get the answer. If they use multiplication or mental math to determine their answers, have them check their answers using division of decimals to see the relationship between the two methods and to check for accuracy.

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Answers to the chart are shown below.

<i>Final Daily Balance</i>	<i># of Pennies (\$0.01)</i>	<i># of nickels (\$0.05)</i>	<i># of dimes (\$0.10)</i>	<i># of quarters (\$0.25)</i>
<i>Example \$34.50</i>	<i>3450</i>	<i>690</i>	<i>345</i>	<i>138</i>
<i>Day 1 -- \$21.00</i>	<b>2100</b>	<b>420</b>	<b>210</b>	<b>84</b>
<i>Day 2 -- \$35.50</i>	<b>3550</b>	<b>710</b>	<b>355</b>	<b>142</b>
<i>Day 3 -- \$69.00</i>	<b>6900</b>	<b>1380</b>	<b>690</b>	<b>276</b>
<i>Day 4 -- \$121.00</i>	<b>12100</b>	<b>2420</b>	<b>1210</b>	<b>484</b>
<i>Day 5 -- \$234.50</i>	<b>23450</b>	<b>4690</b>	<b>2345</b>	<b>938</b>

### COMMON MISCONCEPTIONS

- *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 *groups of* interchangeably can assist with the contextual understanding.

### ESSENTIAL QUESTIONS

- What happens when we divide a decimal by a decimal?
- How do the rules of multiplying whole numbers relate to multiplying decimals?

### MATERIALS

- “How Much Money?” recording sheet

### GROUPING

Individual/Partner task

### TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:

#### TASK

Students will follow the directions below from the “How Much Money?” recording sheet.

You have been asked by your school principal to help count the money at your school store. Your job is to determine how many pennies (\$0.01), nickels (\$0.05), dimes (\$0.10), and quarters (\$0.25) you have at the end of the day.

Complete the chart below and determine the maximum number of each type of coin that can be found in the final daily school store balance.



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Final Daily Balance	# of Pennies (\$0.01)	# of nickels (\$0.05)	# of dimes (\$0.10)	# of quarters (\$0.25)
<i>Example \$34.50</i>	3450	690	345	138
Day 1 -- \$21.00				
Day 2 -- \$35.50				
Day 3 -- \$69.00				
Day 4 -- \$121.00				
Day 5 -- \$234.50				

After you have completed the chart, answer the questions below. Be prepared to share your answers with the class.

1. How can you be assured your answers are correct? *Students should be able to “prove” their solutions make sense and be able to show how they arrived at their solution.*
2. How did you find your individual solutions?
3. Can you think of another method to find the number of coins in your daily balance?
4. Do you see any patterns? If so, what are they? *Various responses may be noted here. One possible response could be that “dimes are half the number of nickels each time.” Another response could be that the “number of nickels is five times the number of pennies.”*

**FORMATIVE ASSESSMENT QUESTIONS**

- How did you think about this problem?
- What operation did you use to find the number of pennies? Nickels? Dimes? Quarters?
- Is there another way you could have found the number of pennies? Nickels? Dimes? Quarters? Which method is more efficient? Which method is easier to do in your head?
- Do you notice any patterns as you look down each column? As you look across each row?

**DIFFERENTIATION**

**Extension**

- Have the students determine how many ways they can create the final daily balance with different combinations of coins. (Example: \$21.00 = 2100 pennies, or 80 quarters and 400 pennies, or...)

**Intervention**

- Use manipulatives and/or real coins to model smaller amounts of money before moving to the recording sheet.

Name \_\_\_\_\_ Date \_\_\_\_\_

## How Much Money?

You have been asked by your school principal to help count the money at your school store. Your job is to determine how many pennies (\$0.01), nickels (\$0.05), dimes (\$0.10), and quarters (\$0.25) you have at the end of the day.



Complete the chart below and determine the maximum number of each type of coin that could be found in the final daily school store balance.

Final Daily Balance	# of Pennies (\$0.01)	# of nickels (\$0.05)	# of dimes (\$0.10)	# of quarters (\$0.25)
<i>Example</i> \$34.50	3450	690	345	138
Day 1 -- \$21.00				
Day 2 -- \$35.50				
Day 3 -- \$69.00				
Day 4 -- \$121.00				
Day 5 -- \$234.50				



## **Constructing Task: Place the Point!**

*Adapted from “Where Does the Decimal Go?” from Zeroing in on Number and Operations: Key Ideas and Common Misconceptions, Grades 5-6.*

In this task, students will use estimation to determine where to place the decimal point in several quotients. The digits remain the same; however, the value will change.

### **STANDARDS FOR MATHEMATICAL CONTENT**

*Understand the place value system.*

**MCC5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

Most students struggle with division of whole numbers and become even more confused once decimals are introduced. Make sure that students are proficient with whole number division first. Then, incorporate a lot of varied problems and computations with decimals as they build that proficiency. Some students will come to class having been told by parents or siblings that you just have to move the decimal over in the divisor to make it a whole number and move the decimal in the dividend the same number of places. Students that remember this “trick” should be encouraged to explain why this works. These students may benefit from doing more estimation with decimals before engaging in formal computations that require an exact answer.

### **COMMON MISCONCEPTIONS**

- *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 *groups of* interchangeably can assist with the contextual understanding.

### **ESSENTIAL QUESTIONS**

- How can we efficiently solve multiplication and division problems with decimals?
- How can we multiply and divide decimals fluently?
- What strategies are effective for finding a missing factor or divisor?
- How can we use estimation to assist in solving problems with decimal operations?

### **MATERIALS**

- “Place the Point” recording sheet
- Calculators (optional)

### **GROUPING**

Small group/Individual task

### **TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

Comments: A great deal of emphasis has been put on paper-and-pencil algorithms when solving problems with decimals. The focus is often put on how to do the problem rather than on what makes sense. Students should be given many opportunities to calculate decimals mentally. The emphasis shifts from getting exact answers from paper-and-pencil calculations to arriving at estimates and being able to explain why they are reasonable.

### **TASK:**

The digits in the computation below are all correct, but the decimal point has been removed.

$$169 \div 4 = 4225$$

Use only estimation to find the quotients of the following. Justify each response, then check your answers using a calculator. If your solution is incorrect, fix the answer and your justification.

- a.  $169 \div 0.4 =$
- b.  $16.9 \div 4 =$
- c.  $16.9 \div 0.4 =$
- d.  $169 \div 40 =$

**FORMATIVE ASSESSMENT QUESTIONS**

- How did you get your answer?
- How do you know your answer is correct?
- What patterns are you noticing?

**DIFFERENTIATION:**

**Extension**

- Have students create problems of their own, not placing the decimal in the problem as done in the task, and swap with another student

**Intervention**

- Use small numbers with only a decimal in the dividend



Name \_\_\_\_\_ Date \_\_\_\_\_

## Place the Point!

The digits in the computation below are all correct, but the decimal point has been removed.

$$169 \div 4 = 4225$$

Use only estimation to find the quotients of the following. Justify each response.

a.  $169 \div 0.4 =$

b.  $1.69 \div 4 =$

c.  $16.9 \div 0.4 =$

d.  $169 \div 80 =$



## Practice Task: Super Slugger Award

In this task, students work to determine baseball players' batting averages, represent the data in a graph, and then determine the recipient of a "Super Slugger Award."

### STANDARDS FOR MATHEMATICAL CONTENT

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### STANDARDS FOR MATHEMATICAL PRACTICE

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

### BACKGROUND KNOWLEDGE

Answers are shown below along with sample student responses.

1. Figure out the batting averages of each player on the team. Round each batting average to the thousandths decimal place. Remind students that in order to find a hitter's batting average you divide the number of hits (h) a player gets by the number of times they have been to bat (b);  $h \div b$ .

Player	Number of Hits	Number of Times at Bat	Batting Average
K. Smith	25	76	<b>0.328</b>
T. Rusch	33	80	<b>0.412</b>
A. Patrick	51	96	<b>0.531</b>
K. Waldrop	18	59	<b>0.305</b>
P. Corbett	29	62	<b>0.467</b>
J. Mark	29	64	<b>0.453</b>
C. Mudd	42	71	<b>0.591</b>
C. Cohen	38	67	<b>0.567</b>
D. Kirkland	37	61	<b>0.606</b>

2. Use the

information that you collected to organize and display the data using the most appropriate graph.

3. Explain who should receive the *Super Slugger Award* from the team and why you feel the player deserves it. *Overall best batting average would go to D. Kirkland. Students should note mention that 0.606 is the largest number of all the batting averages.*

**ESSENTIAL QUESTIONS**

- How do we find the average?
- Why do our quotients include decimals?

**MATERIALS**

- “Super Slugger Award” recording sheet

**GROUPING**

Individual/Partner task

**TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

**TASK:**

Students will follow the directions below from the “Super Slugger Award” Recording Sheet.

Congratulations! Your baseball team has made it to the World Series Little League Baseball Championship. The team has won a record-setting twelve games in a row, with an overall record of 23 wins and only 4 losses.

Your coach needs your help. He is having a hard time figuring out which player on the team has the best batting average and has asked for your assistance.

Your job has three parts.

1. Determine the batting averages of each player on the team. (Round each batting average to the thousandths decimal place.) *Remember that in order to find a hitter’s batting average you divide the number of hits (h) a player gets by the number of times they have been to bat (b);  $h \div b$ .*
2. Use the information that you collected to organize and display the data using the most appropriate graph.
3. Explain who should receive the *Super Slugger Award* from the team and why you feel the player deserves it.

Player	Number of Hits (h)	Number of Times at Bat (b)	Batting Average
K. Smith	25	76	
T. Rusch	33	80	
A. Patrick	51	96	
K. Waldrop	18	59	
P. Corbett	29	62	
J. Mark	29	64	
C. Mudd	42	71	
C. Cohen	38	67	
D. Kirkland	37	61	



### **FORMATIVE ASSESSMENT QUESTIONS**

- To how many place values do you need to divide? Why?
- What is an appropriate graph for this data? Why do you think so?
- What are the disadvantages of using this type of graph? What are the advantages?
- What criteria did you use to determine the student who deserves the Super Slugger Award? Who else could deserve this award?

### **DIFFERENTIATION**

#### **Extension**

- Have the students look in the sports page for the batting averages of a minor or major league baseball team and construct graphs to represent the data.
- Have the students see if they can find the number of hits for a player, given only the batting average and the number of times at bat.

#### **Intervention**

- Teachers can create their own line-up with fewer players to meet the needs of their students.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Super Slugger Award Recording Sheet

Congratulations! Your baseball team has made it to the World Series Little League Baseball Championship. The team has won a record-setting twelve games in a row, with an overall record of 23 wins and only 4 losses.

Your coach needs your help. He is having a hard time figuring out which player on the team has the best batting average and has asked for your assistance.

Your job has three parts.

1. Determine the batting averages of each player on the team. (Round each batting average to the thousandths decimal place.) *Remember that in order to find a hitter's batting average you divide the number of hits (h) a player gets by the number of times they have been to bat (b);  $h \div b$ .*
2. Use the information that you collected to organize and display the data using the most appropriate graph.
3. Explain who should receive the *Super Slugger Award* from the team and how you would justify your choice.



Player	Number of Hits (h)	Number of Times at Bat (b)	Batting Average
K. Smith	25	76	
T. Rusch	33	80	
A. Patrick	51	96	
K. Waldrop	18	59	
P. Corbett	29	62	
J. Mark	29	64	
C. Mudd	42	71	
C. Cohen	38	67	
D. Kirkland	37	61	



## **Practice Task: Number Puzzles**

In this task, students solve problems using multiplication and division of decimals and find the answers in a number-search puzzle. After students solve the puzzle on the “Number Puzzle” Recording sheet, they create a number puzzle of their own using problems they make and solve. Students then trade papers allowing other students to find the solutions hidden within their number-search puzzle.

### **STANDARDS FOR MATHEMATICAL CONTENT**

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

If your students are not familiar with this type of activity, you may want to share an example of a word search and/or number search with them prior to assigning the task. The number puzzle and solutions are shown below.

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1.  $0.12 \cdot 0.35$
2.  $0.2 \cdot 1.3$
3.  $10.5 \cdot 2.8$
4.  $0.69 \cdot 0.2$
5.  $19.87 \times 0.4$
6.  $12.288 \div 3.2$
7.  $200.5 \div 2.5$
8.  $\frac{1.26}{3}$
9.  $\frac{7.23}{0.01}$
10.  $15.9 \div 0.6$



0	.4	2	1	4	8	3.
.1	8	1	8	0.	2	8
3	8	.2	3	7	8.	4
8	.0	6	2	9.	4	3
4	2	6.	5	5	6	7
9	0	7.	9	4	8	5
.0	4	2	8	7	2	3

**ESSENTIAL QUESTIONS**

- How do we multiply decimals by decimals?
- How does multiplying decimals affect the product?
- How do we divide decimals by decimals?
- How does dividing decimals affect the quotient?

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- “Number Puzzle” recording sheet
- “Create-a-Number Puzzle” recording sheet

**GROUPING**

Individual/Partner task

**TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

Comments:

Students may use a calculator to check their work before creating their puzzle to ensure accuracy.

**TASK**

Students will follow the directions below from the “Number Puzzle” and “Create-a-Number Puzzle” Recording Sheets.

**Part I**

Find the answers to the given problems hidden in the number search.

1.  $0.12 \cdot 0.35 =$
2.  $0.2 \cdot 1.3 =$
3.  $10.5 \cdot 2.8 =$
4.  $0.69 \cdot 0.2 =$
5.  $19.87 \times 0.4 =$
6.  $12.288 \div 3.2 =$
7.  $200.5 \div 2.5 =$
8.  $\frac{0.126}{3} =$
9.  $\frac{7.23}{0.01} =$
10.  $15.9 \div 0.6 =$

0	.4	2	1	4	8	3.
.1	8	1	8	0.	2	8
3	8	.2	3	7	8.	4
8	.0	6	2	9.	4	3
4	2	6.	5	5	6	7
9	0	7.	9	4	8	5
.0	4	2	8	7	2	3

Encourage students to use estimation and mental math to find as many answers as they can.

**Part II**

Students will create their own number puzzles using the “Create-a-Puzzle” Recording Sheet.

Directions are as follows:

1. Make up five multiplication problems and five division problems. All multiplication/division problems must include decimals.
2. Using the forty-nine squares on your game board, make a number search puzzle with the ten answers to your multiplication/division problems. The answers can be hidden horizontally or vertically in the grid. Fill in any unused spaces with random numbers.

3. Switch your number search puzzle with a partner and try to solve each other's number puzzles.

### **FORMATIVE ASSESSMENT QUESTIONS**

- Can you explain your process for computing with decimals?
- What are your strategies for creating your own number puzzle?
- How can you use estimation to help you find the product? Quotient?

### **DIFFERENTIATION**

#### **Extension**

Encourage students to try to create overlaps with their hidden solutions so that a given number appears in both a vertical and horizontal solution.

#### **Intervention**

Have students work with a partner or in small groups to solve and create the number puzzles.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Number Puzzle



Find the answers to the given problems hidden in the number search.

1.  $0.12 \cdot 0.35 =$

2.  $0.2 \cdot 1.3 =$

3.  $10.5 \cdot 2.8 =$

4.  $0.69 \cdot 0.2 =$

5.  $19.87 \times 0.4 =$

6.  $12.288 \div 3.2 =$

7.  $200.5 \div 2.5 =$

$$\frac{0.126}{3} =$$

8.  $\frac{7.23}{0.01} =$

9.  $15.9 \div 0.6 =$

0	.4	2	1	4	8	3.
.1	8	1	8	0.	2	8
3	8	.2	3	7	8.	4
8	.0	6	2	9.	4	3
4	2	6.	5	5	6	7
9	0	7.	9	4	8	5
.0	4	2	8	7	2	3

Name \_\_\_\_\_ Date \_\_\_\_\_

## Create - a - Number Puzzle



1. Make up five multiplication problems and five division problems. All multiplication/division problems must include decimals.
2. Using the forty-nine squares on your game board, make a number search puzzle with the ten answers to your multiplication/division problems. The answers can be hidden horizontally or vertically in the grid. Fill in any unused spaces with random numbers.
3. Switch your number search puzzle with a partner and try to solve each other's number puzzles.

Write your number problems below.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_

Create your number puzzle below.


### Practice Task: What's My Rule?



In this task, students will work to discover an unstated rule that the teacher is using to find outcomes.

### **STANDARDS FOR MATHEMATICAL CONTENT**

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

Students may soon realize that by using 1 as their suggested number, the result will clearly show the rule. Since one is the multiplicative identity, any number times one will equal itself. For example, using the sample table above, if the rule is  $n \cdot 0.25$  and students suggest the number 1, the rule is seen immediately in the result of  $1 \cdot .25 = .25$ . Once students start using this strategy for uncovering the rule, you may need to eliminate 1 as a number that students can suggest.

The second sample table gives the rule  $n \div 0.01$ . This rule gives the same result as  $n \times 100$ . This is a great problem to get students to rethink their understanding of the relationship between multiplication and division. If a student suggests  $n \times 100$ , be clear that this could be the rule, but isn't the one you had planned. Push students to determine another possibility to elicit the actual rule for the table. They should have had enough experience with dividing decimals that it will be apparent to them.

### **COMMON MISCONCEPTIONS**

Students may not understand that multiplication and division of decimals are inverse operations. If they have never used an input/output table, they may not understand how it works. They may try a different rule with each entry in the table.

### **ESSENTIAL QUESTIONS**

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- What are some patterns that occur when multiplying and dividing by decimals?
- What strategies are effective for finding a missing factor or divisor?

**MATERIALS**

- Overhead projector, white/chalk board, or computer projector
- Scratch paper
- “Guess My Rule” problems (pre-determined)

**GROUPING**

Whole group/small group task

**TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

Comments:

When creating problems to present to the class, think about the level of difficulty of each problem and the order in which you present the problems.

Students will need time to consider number relationships after each entry, so encourage students to be patient and quiet during this time. When first doing this activity, you may want to begin with simpler rules such as adding or subtracting a number and then work toward using multiplication and division.

The teacher will want to decide on a predetermined rule for an input/output table. The students are asked to give numbers and the teacher will complete the chart using the predetermined rule. This process continues until several entries are in the table. When students think they’ve discovered the rule, they should keep it to themselves while other students are still trying to determine the rule. Here are some sample “rule tables.”

NOTE: When recording the table for students to see, the rule is not to be displayed initially.

<b>Rule: <math>x \cdot 0.25</math></b>	
<b>In</b>	<b>Out</b>
3	0.75
5	1.25
7	1.75
10	2.5
12	3

<b>Rule: <math>n \div 0.01</math></b>	
<b>In</b>	<b>Out</b>
3	300

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6	600
10	1,000
15	1,500
0.1	10

**TASK**

- Draw an input/output table for students to see.
- Tell students you're thinking of a rule for the table and ask them to give you numbers to add to the table. You will then complete the chart for each number they give you.
- After several numbers are entered, students will likely begin to discover the rule. When students think they know the correct rule, give them a number and ask them to use the rule to give you the correct number to record in the table, without actually stating the rule. This will allow you to check their thinking and still allow other students to think independently.
- When students have discovered the rule, have a discussion about the strategies they used to determine the rule.

**FORMATIVE ASSESSMENT QUESTIONS**

- What strategies are you using to determine the rule?
- At what point did you know your prediction for the rule was correct?
- How did you know for sure your rule was correct?

**DIFFERENTIATION**

**Extension**

- Have students develop their own rule tables to share with partners or in small groups.

**Intervention**

- Begin with simpler rules and have students explain their thinking so any misconceptions can be addressed immediately.

**TECHNOLOGY LINK**

<http://www.mathplayground.com/functionmachine.html>



## **Practice Task: Do You See an Error?**

In this task, students will look for errors in student work, find the correct solution, and write a letter to the students regarding the error and how it is corrected.

### **STANDARDS FOR MATHEMATICAL CONTENT**

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

Students should be able to check the placement of the decimal point quickly by estimating the product,  $24 \times 11 = 264$ . Therefore, students should find that the decimal is not placed correctly in the first example. For the second example, both the dividend and the divisor were multiplied by 100 to create an easier problem,  $1468 \div 2$ . Again, the student placed the decimal incorrectly, because the estimate would be  $1500 \div 2 = 750$ .

### **COMMON MISCONCEPTIONS**

Students may line up the decimal points in a multiplication problem as in addition and subtraction. Students may fail to recognize the incorrect placement of the decimal point.

### **ESSENTIAL QUESTIONS**

- What happens when we multiply a decimal by a decimal?
- What happens when we divide a decimal by a decimal?
- How can we check for errors in multiplication or division of decimals?

**MATERIALS**

- “Do You See an Error?” recording sheet

**GROUPING**

Individual/partner task

**TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

**Comments:**

Finding and explaining errors is a powerful way for students to further develop their thinking about their own strategies for solving problems. It not only causes them to closely examine the solutions, but also may prevent them from making the same mistakes.

Using student work from your classroom as an “error analysis warm-up” on a regular basis can help students begin to find and appropriately address errors in their work with greater success.

NOTE: When using actual student work, always conceal student names to protect their identity. Whenever possible, use work from a different class or a previous class with the student’s identity concealed.

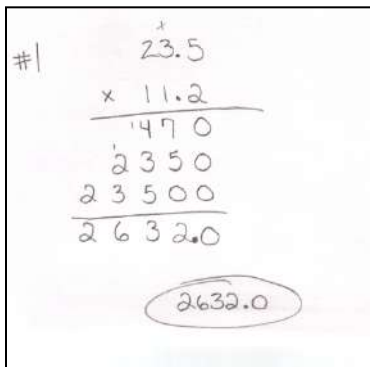
**TASK:**

Students will follow the directions below from the “Do You See an Error?” recording sheet.

Below are samples of two students’ work. Your job is to determine if they have the correct solution to the problem. If a student has the wrong solution, your next assignment is to:

1. Find the student error in each example.
2. Find the correct solution, using two different strategies.
3. Write a note to the student explaining where they went wrong and the steps they need to take to correct their mathematical thinking.

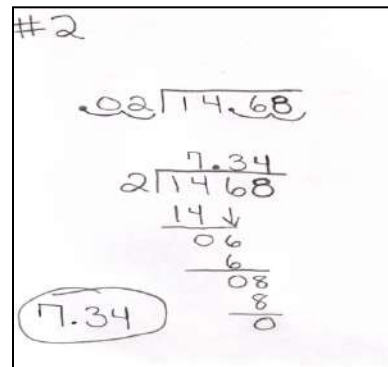
Sample student work:



#1

$$\begin{array}{r} 23.5 \\ \times 11.2 \\ \hline 470 \\ 2350 \\ 23500 \\ \hline 2632.0 \end{array}$$

2632.0



#2

$$\begin{array}{r} 2 \overline{)1468} \\ \underline{14} \phantom{00} \\ 06 \phantom{00} \\ \underline{6} \phantom{00} \\ 08 \phantom{00} \\ \underline{8} \\ 0 \end{array}$$

7.34

### **FORMATIVE ASSESSMENT QUESTIONS**

- How did you know that there is an error in the student work?
- How could estimation help you find an error?
- How will you explain the error and how to correct it?
- How can doing this task keep you from making the same errors?

### **DIFFERENTIATION**

#### **Extension**

- Give students sample problems with multiple errors that involve not only decimal placement, but also computational errors. Have them explain all errors.
- <http://illuminations.nctm.org/LessonDetail.aspx?id=L252> Activity 3 in the “Too Big or Too Small?” lesson gives a related exploration.

#### **Intervention**

- Revisit the “Patterns-R-Us” task of this unit. Encourage students to use the patterns found from that task to estimate answers for the students’ work.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Do You See an Error? Recording Sheet

Below are samples of two students' work. Your job is to determine if they have the correct solution to the problem.

If a student has the wrong solution, your next assignment is to:

1. Find the student error in each example.
2. Find the correct solution, using two different strategies.
3. Write a note to the student explaining their error and the steps they need to take to correct their mathematical thinking.



Student #1 (Hannah)

#1

$$\begin{array}{r}
 23.5 \\
 \times 11.2 \\
 \hline
 470 \\
 2350 \\
 23500 \\
 \hline
 2632.0
 \end{array}$$

2632.0

Student #2 (Randy)

#2

$$\begin{array}{r}
 2 \overline{) 14.68} \\
 \underline{14} \phantom{00} \\
 06 \\
 \underline{06} \\
 08 \\
 \underline{08} \\
 0
 \end{array}$$

7.34



## Practice Task: Road Trip

In this task, students determine fuel costs for a trip through the Southeast of the United States using a given cost of fuel and the number of miles per gallon the family car gets.

### STANDARDS FOR MATHEMATICAL CONTENT

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### STANDARDS FOR MATHEMATICAL PRACTICE

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

### BACKGROUND KNOWLEDGE

You may want to begin this task with a short class discussion about trips, costs of gasoline, and budgets for vacation.

How many miles is it from the starting point to the stopping point on each day?

<b>TRAVELING DAYS</b>	<b>Starting Point</b>	<b>Stopping Point</b>	<b>Total Number of Miles</b>
<b>DAY ONE</b>	Your Home Town	Birmingham, AL	<b>will vary</b>
<b>DAY TWO</b>	Birmingham, AL	Dallas, TX	<b>641.75</b>
<b>DAY THREE</b>	Dallas, TX	Memphis, TN	<b>452.56</b>
<b>DAY FOUR</b>	Memphis, TN	Chattanooga, TN	<b>343.49</b>
<b>DAY FIVE</b>	Chattanooga, TN	Atlanta, GA	<b>118.39</b>
<b>DAY SIX</b>	Atlanta, GA	Your Home Town	<b>will vary</b>

Make sure that students have access to maps, an atlas, or the Internet to determine the total number of miles between the cities. Also, be sure students are careful when they carry their daily miles over from one day to the next.



### **COMMON MISCONCEPTIONS**

Students may multiply the number of miles by the cost of a gallon of gas, without taking into account how many miles the car can travel on each gallon of gas. They could use the wrong operation when figuring miles per tank of gas.

### **ESSENTIAL QUESTIONS**

- What happens when we multiply a decimal by a decimal?
- What happens when we divide a decimal by a decimal?
- How do you know which operation to use?

### **MATERIALS**

- “Road Trip” recording sheet
- Maps, atlases, and/or internet access
- Markers or highlighters

### **GROUPING**

Individual/partner task

### **TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

#### Comments:

As a class, determine the price you will be using for gasoline. You may want to use the local price while working on the project. For consistency, it will be easier for students to use the same price for the entire trip.

If the primary goal of this task is using decimal numbers in a problem solving setting, you may consider having students use an online mapping service because they will give distances to the closest hundredth of a mile.

#### **TASK:**

Students will follow the directions below from the “Road Trip” Recording Sheet.

You and your family want to take a road trip. However, before your family can begin this wonderful adventure, you must first determine how much your trip is going to cost. You are responsible for figuring out how much money you will need for gas.

Using different resources in your classroom, determine how many miles it is to each day’s planned stopping point from the starting point.

Your family car can travel 21.2 miles on one gallon of gasoline.

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<b>DRIVING DAYS</b>	<b>Starting Point</b>	<b>Stopping Point</b>
<b>DAY ONE</b>	Your Home Town	Birmingham, AL
<b>DAY TWO</b>	Birmingham, AL	Dallas, TX
<b>DAY THREE</b>	Dallas, TX	Memphis, TN
<b>DAY FOUR</b>	Memphis, TN	Chattanooga, TN
<b>DAY FIVE</b>	Chattanooga, TN	Atlanta, GA
<b>DAY SIX</b>	Atlanta, GA	Your Home Town

1. How many miles is it from each day's starting point to the stopping point?
2. How much will it cost your family to make the trip each day? What is the total cost of gasoline for the entire trip? Assume that when your family reaches the stopping point, the car is not driven until the next day.
3. Use the information you collected to organize and display the data using the most appropriate graph.
4. Show at least two of your computations and explain your thinking in words.
5. If your family car's gas tank holds 19.7 gallons of fuel, how far (in miles) can your family car travel on one tank of gasoline? Two tanks? Five tanks?
6. How long will your family spend traveling between cities if your average speed is 65 miles per hour?

### **FORMATIVE ASSESSMENT QUESTIONS**

- Explain your strategy for determining daily mileage.
- How are you organizing your work for this task?
- How does this task help you understand the importance of budgeting for a trip?

### **DIFFERENTIATION**

#### **Extension**

- Have students share other cities they could visit at the end of their road trip if they left Atlanta, GA before they had to fill up with gas again. Have them explain why they would/could visit those cities?
- You may want to allow students to use a calculator to check their work after they have completed the task to check for accuracy.
- Have students create a trip they would want to take and determine mileage and cost of gas.
- Have students create a budget for an entire trip that includes cost of gasoline, lodging, and an estimate for food and entertainment.

#### **Intervention**

- Give students one city at a time to compute the distance.
- Provide an organizer on which students can record the information required to find costs.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Road Trip Recording Sheet



You and your family want to take a road trip. However, before your family can begin this wonderful adventure you must first determine how much your trip is going to cost. You are responsible for figuring out how much money you will need for gas.

Using different resources in your classroom, determine how many miles it is to each day's planned stopping point from the starting point.

Your family car can travel 21.2 miles on one gallon of gasoline.

DRIVING DAYS	Starting Point	Stopping Point
DAY ONE	Your Home Town	Birmingham, AL
DAY TWO	Birmingham, AL	Dallas, TX
DAY THREE	Dallas, TX	Memphis, TN
DAY FOUR	Memphis, TN	Chattanooga, TN
DAY FIVE	Chattanooga, TN	Atlanta, GA
DAY SIX	Atlanta, GA	Your Home Town

Be sure to answer all the questions below.

- How many miles is it from each day's starting point to the stopping point?
- How much will it cost your family to make the trip each day? What is the total cost of gasoline for the entire trip? Assume that when your family reaches the stopping point, the car is not driven until the next day.
- Use the information you collected to organize and display the data using the most appropriate graph.
- Show at least two of your computations and explain your thinking in words.
- If your family car's gas tank holds 19.7 gallons of fuel, how far (in miles) can your family car travel on one tank of gasoline? Two tanks? Five tanks?
- How long will your family spend traveling between cities if your average speed is 65 miles per hour?

**MULTIPLYING AND DIVIDING DECIMALS**



## **Performance Task: Teacher for a Day**

This performance task represents the level of depth, rigor and complexity expected of all fifth grade students to demonstrate evidence of learning.

In this task, students represent and explain their understanding about how to multiply and divide decimals, their understanding of the place value system, and their knowledge of how decimals are used throughout life. Also, students are asked to explain and communicate why decimals are important. Finally, students are asked to teach the process of multiplying and dividing decimals. They can either create a lesson on PowerPoint or Prezi, or create visual displays with posters and markers.

### **STANDARDS FOR MATHEMATICAL CONTENT**

*Understand the place value system.*

**MCC5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

Students should demonstrate a conceptual understanding of operations with decimals as opposed to a purely procedural knowledge. For example, students should understand that if they are multiplying tenths by tenths, the product must be expressed as hundredths. (i.e.,  $1/10 \times 1/10 = 1/100$ ). Students should also know to round to the nearest whole number and estimate to place the decimal, using the estimate to determine the reasonableness of an answer, rather than only knowing to count the digits after the decimal point to place the decimal point in the answer.

When multiplying or dividing decimals, students should demonstrate an understanding of place value and digit values rather than only showing the algorithmic steps one could use to divide. Students should show the operations using base ten blocks and/or partial products or quotients (rather than procedural steps), demonstrating an understanding of the operations modeled.

### **ESSENTIAL QUESTIONS**

- How are multiplication and division related?
- What happens when we multiply a decimal by a decimal?
- What happens when we divide a decimal by a decimal?
- How do the rules of multiplying whole numbers relate to multiplying decimals?

### **MATERIALS**

- Access to computer to create a PowerPoint, Prezi, or similar computer project; alternately, poster paper and markers to create visual displays

### **GROUPING**

Individual/Partner/Small group task

### **TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

#### **Comments:**

While this task may serve as a summative assessment, it may also be used for teaching and learning. It is important that all elements of the task be addressed throughout the learning process so that students understand what is expected of them.

### **TASK**

Students will follow the directions below from the “Teacher for a Day” recording sheet. Your fifth grade teacher has asked for your help. A teacher friend who teaches at Old Mill Elementary School has a fifth grade class that is having difficulty with multiplying and dividing decimals.

Your teacher knows that you are an expert at multiplying and dividing decimals. With your partner, create a presentation that addresses the following items:

1. Explanation of the place value system
2. How to multiply decimals
3. How to divide decimals
4. When good multiplication and division skills with decimals are needed and why they are important

Your presentation should include examples and visual models to help the fifth grade class at Old Mill Elementary School have a clear understanding of how to work with decimals. Remember, your presentation needs to have multiple representations using pictures, numbers, and/or words.

Be prepared to give a practice presentation to your classmates.

### **FORMATIVE ASSESSMENT QUESTIONS**

- What models are you going to use to show examples of multiplying and dividing decimals?
- How do you know when to multiply and when to divide with decimals?

### **DIFFERENTIATION**

#### **Extension**

- Have students include in their presentation an explanation of the relationship between multiplication and division of decimals.
- Have students include examples of when these skills are used in daily life.

#### **Intervention**

- Have students give their responses to the portions of the task verbally before asking students to put their explanations in writing.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Teacher for a Day Task Directions



Your fifth grade teacher has asked for your help. A teacher friend who teaches at Old Mill Elementary School has a fifth grade class that is having difficulty with multiplying and dividing decimals.

Your teacher knows that you are an expert at multiplying and dividing decimals. With your partner, create a presentation that addresses the following items:

1. Explanation of the place value system
2. How to multiply decimals
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4. When good multiplication and division skills with decimals are needed and why they are important

Your presentation should include examples and visual models to help the fifth grade class at Old Mill Elementary School have a clear understanding of how to work with decimals. Remember, your presentation needs to have multiple representations using pictures, numbers, and/or words.

Be prepared to give a practice presentation to your classmates.





## **Performance Task: Bargain Shopping**

This culminating task represents the level of depth, rigor and complexity expected of all fifth grade students to demonstrate evidence of learning.

In this task, students will determine the best store to buy certain items on their list of needed school supplies. Students will determine how much money they will have left after making appropriate purchases. With the remaining money from their original purchases, students are asked whether or not they can purchase school supplies for their siblings.

### **STANDARDS FOR MATHEMATICAL CONTENT**

*Understand the place value system.*

**MCC5.NBT.2** Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

*Perform operations with multi-digit whole numbers and with decimals to the hundredths.*

**MCC5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

### **BACKGROUND KNOWLEDGE**

You may want to have some class discussions about what constitutes a good value before beginning this task. Students may have different answers for Question 3 based on prior experiences of what “better” means to them. Have students justify their answers.

### **ESSENTIAL QUESTIONS**

- How do the rules of multiplying whole numbers relate to multiplying decimals?

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- How can we multiply and divide decimals fluently?
- How do we solve problems with decimals?

**MATERIALS**

- “Bargain Shopping” Recording Sheet
- Sale Papers for Canton Supplies and Cherokee Discounts

**GROUPING**

Individual/Partner/Small group task

**TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION:**

**Comments:**

While this task may serve as a summative assessment, it also may be used for teaching and learning. It is important that all elements of the task be addressed throughout the learning process so that students understand what is expected of them. Students may want to practice their estimation skills before participating in this activity.

You may want to have students bring in copies of local advertisements from the newspaper to use for a similar introductory activity. Also, you may want to collect advertisements during the first week of school and save them until you are ready to use them. This way, students could purchase supplies from the store they think offers a better buy.

**TASK:**

Students will follow the directions below from the “Bargain Shopping” Recording Sheet.

It is time to go shopping for school supplies for next school year. You have ads from two local stores indicating their prices (which include sales tax) for different school supplies. Your mother has given you \$45.50 to spend, and wants you to find the best prices on things you will need.

**School Supplies Needed**














Eight folders  
One calculator  
Two packs of regular lined notebook paper (pack of 500 sheets)  
Three rulers  
Three bottles of glue  
Thirty-three pencils  
Ten pens  
Five spiral notebooks  
Two backpacks










1. Determine the cheapest price for each item on your list of school supplies needed. From which store would you buy each school supply? How much money will you have to spend? How much of the \$45.50 will you have left over?

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2. With the remaining money, you decide to buy each of your three siblings the same school supply item. What item would you purchase?
3. Is one store better than the other? Why or why not?
4. If you could choose only one store, which would it be? Explain your reasoning by writing an overall summary of your findings.

See sale papers from two different stores shown below.

CHEROKEE DISCOUNTS		
<p><b>Calculator</b> \$6.99</p> 	<p><b>Lined Paper</b> 500 sheets      93¢</p> 	<p><b>Folder</b> 15¢ each</p> 
<p><b>Erasers – large</b> 52¢ each</p> 	<p><b>Clipboard</b> \$2.15</p> 	<p><b>Book Covers</b> 4 for \$2.00</p> 
<p><b>Glue</b> 2 oz. bottle</p>  <p>95¢</p>	<p><b>Backpack</b> \$8.97</p> 	<p><b>Pencils</b></p>  <p>11¢ each 10 pack -- \$1.01</p>
<p><b>Scissors</b> \$1.75</p> 	<p><b>Pens</b> 29¢ each \$3.56 – 15 pack</p> 	<p><b>Ruler</b> \$1.45 each</p> 
	<p><b>Spiral Notebooks</b> 99¢ each</p> 	

CANTON SUPPLIES		
<p><b>Calculator</b> \$12.98 – regular price</p> 	<p><b>Lined Paper</b> 500 sheets Regular Price - 47¢</p> 	<p><b>Folders</b> 11¢ each</p> 
<p><b>Erasers – large</b> 60¢ each</p> 	<p><b>Clipboard</b> \$1.99</p> 	<p><b>Book Covers</b> \$1.50</p> 
<p><b>Glue</b> 2 oz. bottle 39¢</p> 	<p><b>Backpack</b> \$8.37</p> 	<p><b>Pencils</b> 69¢ each 10 pack -- \$2.02</p> 

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 <u>Scissors</u> \$2.13	 <u>Pens</u> 35¢ each \$4.08 – 15 pack	 <u>Ruler</u> \$1.14 each
	 <u>Spiral Notebooks</u> 75¢ each	

### **FORMATIVE ASSESSMENT QUESTIONS**

- What is your strategy for completing this task?
- What factors influence your decision about which store has better values?
- How would you determine the store in which you would make your purchases if you had to choose only one store?

### **DIFFERENTIATION**

#### **Extension**

- Have students research prices on websites such as Staples, Wal-Mart, Office Max, Office Depot, etc. and compare total costs with one another.
- Have students plan ways to earn the money necessary for school supplies and other back to school items such as clothes, shoes, computer, etc.
- Have students plan ways to earn money to provide school supplies for students in the community who are unable to purchase back-to-school supplies.

#### **Intervention**

- Have students make an organized list of the items and the prices at both stores to help them make comparisons.

Name \_\_\_\_\_ Date \_\_\_\_\_

## Bargain Shopping Recording Sheet














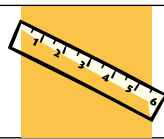














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### School Supplies Needed

Eight folders  
One calculator  
Two packs of regular lined notebook paper (pack of 500 sheets)  
Three rulers  
Three bottles of glue  
Thirty-three pencils  
Ten pens  
Five spiral notebooks  
Two backpacks

1. Determine the cheapest price for each item on your list of school supplies needed. From which store would you buy each school supply? How much money will you have to spend? How much of the \$45.50 will you have left over?
2. With the remaining money, you decide to buy each of your three siblings the same school supply item. What item would you purchase?
3. Is one store a better overall value than the other? Why or why not?
4. If you could choose only one store, which would it be? Explain your reasoning by writing an overall summary of your findings.



<b>CHEROKEE DISCOUNTS</b>		
<p><b>Calculator</b> \$6.99</p> 	<p><b>Lined Paper</b> 500 sheets 93¢</p> 	<p><b>Folder</b> 15¢ each</p> 
<p><b>Erasers – large</b> 52¢ each</p> 	<p><b>Clipboard</b> \$2.15</p> 	<p><b>Book Covers</b> 4 for \$2.00</p> 
<p><b>Glue</b> 2 oz. bottle 95¢</p> 	<p><b>Backpack</b> \$8.97</p> 	<p><b>Pencils</b> 11¢ each 10 pack -- \$1.01</p> 
<p><b>Scissors</b> \$1.75</p> 	<p><b>Pens</b> 29¢ each \$3.56 – 15 pack</p> 	<p><b>Ruler</b> \$1.45 each</p> 
	<p><b>Spiral Notebooks</b> 99¢ each</p> 	
<b>CANTON SUPPLIES</b>		
<p><b>Calculator</b> \$12.98 – regular price</p> 	<p><b>Lined Paper</b> 500 sheets Regular Price - 47¢</p> 	<p><b>Folders</b> 11¢ each</p> 
<p><b>Erasers – large</b> 60¢ each</p> 	<p><b>Clipboard</b> \$1.99</p> 	<p><b>Book Covers</b> \$1.50</p> 
<p><b>Glue</b> 2 oz. bottle 39¢</p> 	<p><b>Backpack</b> \$8.37</p> 	<p><b>Pencils</b> 69¢ each 10 pack -- \$2.02</p> 
<p><b>Scissors</b> \$2.13</p> 	<p><b>Pens</b> 35¢ each \$4.08 – 15 pack</p> 	<p><b>Ruler</b> \$1.14 each</p> 
	<p><b>Spiral Notebooks</b> 75¢ each</p> 	

## **CULMINATING TASK: Field Trip**

*Adapted from Bowland Maths*

This culminating task represents the level of depth, rigor, and complexity expected of all fifth grade students to demonstrate evidence of learning. Students will plan a field trip and analyze how to determine the most cost effective trip based on the given data. In order to do this, students will need to use reasoning to: determine which trip should be taken, calculate costs for one trip, and use repeated reasoning to explain how to compare costs on other trips.

### **STANDARDS FOR MATHEMATICAL CONTENT**

**MCC5.NBT.4 Use place value understanding to round decimals to any place. Perform operations with multi-digit whole numbers and with decimals to hundredths.**

**MCC5.NBT.7 Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.**

### **STANDARDS FOR MATHEMATICAL PRACTICE**

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

- 1. Reason abstractly and quantitatively.**
- 2. Construct viable arguments and critique the reasoning of others.**
- 3. Model with mathematics.**
- 4. Use appropriate tools strategically.**  
**Attend to precision.**
- 5. Look for and make use of structure.**
- 6. Look for and express regularity in repeated reasoning.**

### **BACKGROUND KNOWLEDGE**

Students should have had many opportunities to identify, read, and illustrate decimal numbers. Students' work will represent some uniqueness based on how they approach the problem. Students will need to reflect on their own understanding of place value and decimal operations.

### **ESSENTIAL QUESTIONS**

- What factors should be taken into consideration when deciding where to go on a field trip?
- How can decimal computation help people make decisions?

### **MATERIALS**

- “Field Trip” task sheet.

## **GROUPING**

Individual/Partner Task

## **TASK DESCRIPTION, DEVELOPMENT, AND DISCUSSION**

### **Comments**

Students should be given opportunities to revise their work based on teacher feedback, peer feedback, and metacognition which includes self-assessment and reflection.

### **Suggestions for Classroom Use**

While this task may serve as a summative assessment, it also may be used for formative assessment and/or as a project. It is important that all elements of the task be addressed throughout the learning process so that students understand what is expected of them.

### **Task Directions**

Students will follow the directions below from the “Field Trip” students recording sheet.

Mr. Richards, a teacher at Crosstown Elementary School, plans to take 30 students on a school trip. The class voted on which place to visit.

The following questions can be asked to make sure the students understand the situation:

- Which place has the cheapest entrance fee?
- Which place is nearest?
- What are Lucy’s first and second choices?
- How much do teachers have to pay?
- How much will the school pay towards the total cost of the trip?

## **FORMATIVE ASSESSMENT QUESTIONS**

- How would you find the total cost for going on the \_\_\_\_\_ field trip?
- How does multiplication of decimals help you find the total cost of the field trip?
- How could you do this task without using multiplication?
- What stays the same no matter which field trip the class goes on?
- How is going on the \_\_\_\_\_ field trip different from the \_\_\_\_\_ field trip?
- How could you find out if one of the trips would be the least expensive?
- Taking the total cost into account, which trip will be the cheapest/most expensive?
- How could an expression help you find the total cost of the different trips?

## **DIFFERENTIATION**



**Extension**

- How much would it cost to go on all 3 trips?
- If the bus company charges \$0.40 more per mile, how will this affect the total cost? How would this change affect your decision about which field trip is the best?
- Devise a fund raising plan to ensure that all students could go on all 3 trips.


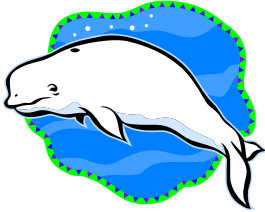

**Intervention**

- Students who have difficulty organizing their work may benefit by working with a partner whose strength is organization, or may need a teacher's assistance in organizing their work before/during the task.

Name \_\_\_\_\_ Date \_\_\_\_\_

**Field Trip**

Mr. Richards, a teacher at Crosstown Elementary School, plans to take 30 students on a school trip. Here are the places they could visit.

<b>Big City Zoo</b>	<b>State Aquarium</b>	<b>Space Science Show</b>
		
36 miles from Crosstown Elementary School Entrance Fee: \$2.50 per person	30 miles from Crosstown Elementary School Entrance Fee: \$6.75 per person	10 miles from Crosstown Elementary School Entrance Fee: \$11.25 per person

The class voted on which place to visit. Here are the results.

	<b>ZOO</b>	<b>STATE AQUARIUM</b>	<b>SPACE SCIENCE SHOW</b>
<b>First Choice</b>	12 Students	8 Students	10 Students
<b>Second Choice</b>	5 Students	14 Students	11 Students

1. Taking first and second choices into account, where do you think Mr. Richards should take his class? Explain how you decided.

**Here are some more facts about the trip.**

- **The bus company charges \$6.29 per mile.**

- The school will pay the first \$200 of the trip.
- Teachers go free.
- Each student pays the same amount.

2. How much will each student need to pay to go on the trip you have chosen?  
Explain your thinking.

3. Explain to Mr. Richards how he could figure out which trip would be the least expensive.