

► Grade 5 Topic 4: Use Models and Strategies to Multiply Decimals

Big Conceptual Idea: [Numbers and Operations in Base Ten](#) (pp. 18-21)

Prior to instruction, view the *Topic 4 Professional Development Video* located in *Pearson Realize* online. Read the *Teacher's Edition (TE): Cluster Overview/Math Background* (pp. 55A-55F), the *Topic Planner* (pp. 163A-163D), all 10 lessons, and the *Topic Assessments* (pp. 235-236A).

<p>Mathematical Background: Read Topics 2-6 Cluster Overview/Math Background (TE, pp. 55A-55F)</p>	<p>Topic Essential Question: What are the standard procedures for estimating and finding products involving decimals?</p> <p><i>Reference Answering the Topic Essential Questions (TE, pp. 231-232) for key elements of answers to the Essential Question.</i></p>
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Topic 4
Use Models and Strategies to Multiply Decimals

Number of lessons: **10**

A/D/E: 3 days

NVACS Focus:
NBT.B

Total days: ~13

The lesson map for this topic is as follows:

4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	Assessment
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3 A/D/E days used strategically throughout the topic

Instructional Note:

The focus of this topic is multiplication with decimals. Instructional emphasis is on "...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." (NVACS, 2010, 5.NBT.B.7). Students have prior experience working with decimals, whole number multiplication, and understanding the place value system. Provide students opportunities to analyze patterns and build number sense using decimal factors in a multiplication problem. Students should notice the similarities between multiplication with whole numbers and decimals and how decimals change the size of a product. This conceptual understanding of decimal multiplication will allow students to determine the reasonableness of their solutions and will lay the groundwork for procedural understanding. Use estimation consistently during this topic as a tool to help students develop number sense and connect strategies for working with whole numbers to decimal multiplication (Van de Walle, Karp, & Bay-Williams, 2016).

A common misconception is that multiplication always results in bigger numbers. While this is true when multiplying *whole* numbers, when a number is multiplied by a decimal or fraction that is less than one, the product is *less* than the whole number factor. For example, 2×3 is 2 "groups of" $3 = 6$. However, 0.2×3 is 0.2 "of" $3 = 0.6$. A piece of the whole number factor instead of groups; or 6 groups of 0.2 (commutative property). The product is less than one of the factors. This concept will be addressed again in Topic 8 when students multiply fractions.

Throughout this topic, students will benefit from working with visual models while multiplying. Consistently use and be precise with language. Use the language "*of, pieces of, and two tenths*" (instead of *point two*) when referring to multiplication and decimals. "This level of precision in language will provide your students the opportunity to *hear* the connections between decimals and fractions" (Van de Walle, et al., p 146).

Math Practice 4: Model with mathematics

Focus on opportunities for students to develop *Mathematical Practice 4* behaviors as this is the focus of the Math Practices and Problem Solving, lesson 4-10. Reference the *Teacher's Edition* (TE, pp. F24-F24A) and the NVACS (2010, p.6).

Essential Academic Vocabulary	
Use these words consistently during instruction.	
<p>New Academic Vocabulary: (First time explicitly taught)</p>	<p>Review Academic Vocabulary: (Vocabulary explicitly taught in prior grades or topics)</p> <p><i>factors</i> <i>products</i> <i>partial products</i> <i>tenths</i> <i>hundredths</i></p>

Additional terminology that students may need support with: base, expanded form, exponential form, standard form, powers of ten

[5th grade Curriculum Pacing Framework:](#)
[Balanced Calendar](#)

Collaborative Team Conversations (CTC)

Consider using *one* of the following as part of the formative assessment process at the lesson level to **collect student work** to analyze for **evidence of mathematical understanding**:

- Guiding questions:**
- “Are students able to estimate products of whole numbers and decimals? Can they explain why their estimate is reasonable?”
 - “Are students using a partial products strategy to multiply factors with decimals?”

Lesson	Evidence	Look for
4-2	<i>Convince Me!</i> (student work samples)	Focus CTC around the big idea: <ul style="list-style-type: none"> • reasoning based on place value understanding to justify estimates. • reasonable estimates for the context of a situation.
4-2	<i>Quick Check</i> (digital platform) Items 1, 2 and 5	Focus CTC around data analysis and collection of student workspace (scratch paper). Printable version available under “Teacher Resources”.
4-6	<i>Homework and Practice</i> (student work samples) Item 14	Focus CTC around the big idea: <ul style="list-style-type: none"> • appropriate strategies and models used to multiply. • correct placement of the decimal.
4-7	<i>Quick Check</i> (digital platform)	Focus CTC around data analysis and collection of student workspace (scratch paper). Printable version available under “Teacher Resources”.

Learning Cycle Assessments (summative)	<i>Topic Performance Assessments</i> SE pp. 231-236	Use <i>Scoring Guide</i> TE pp. 235-236C
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Standards listed in **bold** indicate a focus of the lesson.

NVACS (Content and Practices)	Mathematical Development of the Big Idea	Instructional Clarifications & Considerations
Lesson 4-1: Multiply Decimals by Powers of 10		
<p>5.NBT.A.2</p> <p>MP.2 MP.3 MP.7</p>	<p>Access Prior Learning: In Topic 1, students worked with powers of ten and explored patterns when multiplying by powers of ten (5.NBT.A).</p> <p>Beginning of the Big Idea: Students will extend their understandings of place value and multiplication to develop procedural skills and mental strategies for multiplying decimals by powers of ten. Using estimation and procedures, students will build conceptual understanding of decimals as factors.</p>	<p>Solve and Share: Use questioning to help students connect place value understandings to multiplying with decimals. Students who use structure and mental math are discovering patterns in multiplying decimals by powers of 10. Ask students to share their solutions and explain their thinking. Use questioning to help students to see the patterns in their solutions. Draw out the idea that patterns can be used to multiply by 10, 100, and 1,000.</p> <p>Visual Learning: A common misconception is that when multiplying by powers of 10, zeros can be added to find the product. Consider writing whole numbers with the decimal point in places after the ones place. For example, 36 can also be written as 36.0, 36.00, 36.000 without changing the value. It is important that students understand the place value is changing as they explore the movement of the decimal when multiplying by powers of 10.</p> <p>Assess and Differentiate: Students who see patterns in the products when multiplying by powers of 10 will be able to complete the <i>Guided and Independent Practice</i> problems mentally. If students are still having difficulty seeing or applying these patterns mentally, encourage them to use different representations including charts and tables to draw their attention to the patterns. Students will encounter multiplying by powers of 10, with numbers less than 1 such as 0.1 and 0.01 in the practice problems. Students may again need to see the whole numbers written with zeros in place values that are not represented. Showing how the example of 3.63 can be written as 03.63 will help students to see that this number contains no tens but the place value is still there. This gives students a visual for moving the decimal when multiplying 3.63 by 0.1 or 0.01 and connects to the same patterns used to multiply by 10, 100, and 1,000.</p> <p>If students are able to use patterns to mentally calculate the problems in the <i>Guided and Independent Practice</i> (SE, p. 167) or <i>Homework and Practice</i> (SE, p. 167), move them to the more challenging problems in the <i>Math Practices and Problem Solving</i> (SE, 168) or <i>Homework and Practice</i> (SE, p. 170) to extend their thinking. Ask these students to explain and justify their thinking so that others can benefit from their insights.</p>

Lesson 4-2: Estimate the product of a decimal and a whole number		
<p>5.NBT.B.7</p> <p>MP.2 MP.6 MP.8</p>	<p>Access Prior Learning: Students will use prior experiences with compatible numbers and rounding to estimate (5.NBT.A.4).</p> <p>Developing the Big Idea: Students will build conceptual understanding of decimal as factors through the use of estimation. These understandings will build students number sense and help them to accurately place the decimal point in future problems and to determine when exact products versus an estimate is required.</p>	<p>Solve and Share: Students will need to apply what they know about multiplying with whole numbers to multiplying with decimals. Ask students to explain how they arrived at their estimates; as well as, how they know their estimate is reasonable. Ask, "How do you know if your solution will be too high or too low?" Orchestrate a discussion by asking students who used differing estimation strategies to share. This will highlight several strategies and methods used when forming estimations. Consider using the <i>Look Back!</i> to extend student thinking. Allow students to provide explanations for the methods they used and for determining the reasonableness of their solutions.</p> <p>Visual Learning: Focus on the context of this problem and ask students, "What makes an estimate appropriate?" Two different methods are shown for estimating the product. Consider facilitating a discussion about which method is better for this situation and why. Ask students if they can use these ideas to determine whether their solutions are reasonable for future problems. The <i>Convince Me!</i> offers an opportunity for students to apply their ideas using the same context but with different numbers.</p> <p>Assess and Differentiate: As students complete the practice problems using estimation techniques, continue to challenge them to use multiple methods and to explain whether their estimation will be higher or lower than the exact answer.</p> <p>*CTC: <i>Convince Me!</i> (student work samples) *CTC: <i>Quick Check</i> (digital platform) Items 1, 2 and 5</p>
Lesson 4-3: Use Models to Multiply a Decimal and a Whole Number		
<p>5.NBT.B.7</p> <p>MP.3 MP.4</p>	<p>Access Prior Learning: In Topic 2 students added decimals. In Topic 3, students multiplied whole numbers.</p> <p>Developing the Big Idea: Students will use a model that encourages repeated addition to multiply a whole number and a decimal. This will help them to extend previous understandings of multiplication to include decimals.</p>	<p>Solve and Share: Ask students to model the given problem using the hundredths grids or objects. Encourage students to explain how their models represent the context of the problem. Ask students if their model represents a problem that can be solved using more than one operation and which would be more efficient for this problem. Look for students who use a separate grid for each factor versus those who fit factors together continuously. Consider using multiple colors and a number line in addition to the hundredths grid as visuals to demonstrate how parts join to form wholes.</p> <p>Visual Learning: Students have another opportunity to model a multiplication problem using hundredths grids. Consider having students complete the multiplication problem without the decimals. By comparing the products created by 4×36, 4×360 and 4×3.6, students will connect to previous understanding of patterns and how the decimal is placed when using the U.S. traditional multiplication algorithm.</p> <p>Assess and Differentiate: Offer students the use of tools such as base ten blocks or blank hundredths grids as they practice modeling multiplying a whole number by a decimal.</p>
Lesson 4-4: Multiply a Decimal by a Whole Number		
<p>5.NBT.B.7</p> <p>MP.2 MP.5 MP.6 MP.8</p>	<p>Access Prior Learning: In Topic 3 students estimated and multiplied whole numbers. During Topic 1 students used estimation to round decimals. They will use these concepts together to multiply a decimal by a whole number.</p> <p>Developing the Big Idea: Students will use understandings of multiplication and decimal place value to multiply a whole number and a decimal using a known algorithm and then correctly place the decimal in the product.</p>	<p>Solve and Share: This problem allows students to model with both repeated addition and multiplication. Look for students using multiplicative reasoning on this problem. Some students will be able to represent the different distances in a table and express the rule $t \times 1.15 = d$ (km). Why is multiplication used to solve this problem?</p> <p>Visual Learning: Students are shown that it is possible to multiply the factors without a decimal and then place the decimal into the product. Placing the decimal is not given as a rule. The focus is on using number sense and place value understanding to place the decimal after multiplying with whole numbers. Consider having students generalize a rule based on the patterns in the given examples. Allow students to use different algorithms or strategies such as an area model for multi-digit multiplication. Ask students to use place value understanding and number sense to explain where the decimal is placed and why these methods work to efficiently multiply decimals. Ensure that students build a conceptual understanding prior to being given an abstract rule.</p> <p>Assess and Differentiate: Students should work to see the connection between multiplying whole numbers and decimals. If they are multiplying and placing the decimal with precision, indicating conceptual understanding, they might move to the <i>Math Practices and Problem Solving</i> page to practice with applying their understanding to contextualized problems.</p>

Lesson 4-5: Use Models to Multiply a Decimal and a Decimal		
<p>5.NBT.B.7</p> <p>MP.3 MP.4 MP.5 MP.6 MP.8</p>	<p>Access Prior Learning: In fourth grade students used area models to multiply whole numbers (4.NBT.B.5) and in Topic 3 students used area models to multiply multi-digit whole numbers.</p> <p>Developing the Big Idea: Students will multiply two decimal factors for the first time building on the understanding that when one factor is less than one, the product is less than the larger factor. Students will work with two decimal factors to discover how the product is affected.</p>	<p>Solve and Share: Students will benefit from discussing the value one small square of this grid (1/100) represents before modeling this problem. Note that this problem asks for one possible solution. Consider having students share different plausible solutions and discuss why they are multiple solutions. Help students make connections to previous understandings about factors.</p> <p>Visual Learning: The students will see how overlapping two decimals in the hundredths grid gives a solution to a decimal multiplication problem. The word “of” can help students to understand what this model is demonstrating and why it works. 2×3 is 2 groups “of” 3. Decimals are less than 1, so they take a piece “of” a whole number. Two decimals multiplied together finds a piece “of” a piece. The overlap created on the hundredths grid model visually shows the size of the piece created when two decimals are multiplied. This will later connect to multiplication of fractions.</p> <p>Part C will use two hundredths grids side by side because one of the factors is 1.5. Students often have trouble modeling numbers greater than one when using hundredths grids. Ask students if they can rename the 1.5 into an equivalent value to assist them with thinking about this. Ask students if renaming 1.5 to 15 tenths changes its value. This will help students understand the multiple ways they can reason about value and that either way enables them to use this model to multiply decimals, even when whole numbers are included. (Note: Continue to explore equivalent names for 100 hundredths or 10 tenths to solidify understanding that either of these will make a whole unit and thus 1 “whole” hundredths grid).</p> <p>Assess and Differentiate: Allow students to use a variety of tools such as blank hundredths grids or base 10 blocks to complete the <i>Guided and Independent Practice</i> problems (<i>Teaching Tools 8 and 9, Teacher’s Resource Masters Volume 2</i>). Students will work with numbers greater than 1 on items 4, 7, 8, 10, 11, 14, and 16 (SE, pp. 191-192). Strong base-ten understanding will help students think fluidly about number. Help students make connections between numbers such as 2.1 as 21 tenths and 1.7 as 17 tenths. This understanding of equivalency will help students to see how these numbers can be represented on the hundredths grid models while supporting deeper number sense.</p>
Lesson 4-6: Multiply Decimals Using Partial Products		
<p>5.NBT.B.7</p> <p>MP.1 MP.2 MP.4 MP.5</p>	<p>Access Prior Learning: In Topic 3 students used partial products strategies such as an area model to multiply two digit numbers.</p> <p>Developing the Big Idea: Students will develop conceptual understanding while building procedural skills for multiplying decimals using a partial products strategy.</p>	<p>Solve and Share: Students will use a visual model to multiply two decimal factors, which represents partial products created. Students should connect how strategies for multiplying decimals are similar to those used for whole numbers. Ask students to think about the <i>Look Back!</i> question and share their observations. Draw out the mathematical generalization that the product of two decimals less than one is less than either factor.</p> <p>Visual Learning: An area model is used to visually show the partial products created by multiplying two decimals. Consider asking students to complete the same multiplication problem without the decimals using an area model. Students will be able to see the similarities between the partial products created by both problems and use place value reasoning to think about how decimals are placed in the product created by the decimal factors. Ask students if the example seen here confirms, denies, or changes the generalizations made about the product when multiplying two decimals less than one.</p> <p>Guided and Independent Practice: Have students solve these problems on a blank page to allow use of visual model strategies such as the open area model demonstrated in the <i>Visual Learning Bridge</i>.</p> <p>Assess and Differentiate: The intervention activity models a partial products strategy that could increase conceptual understanding of multiplication for all students. This partial products algorithm does not hide place value. Instead, it shows all of the partial products and is procedurally similar to other standard algorithms for multiplication, including the U.S. traditional algorithm.</p> <p>*CTC: <i>Homework and Practice</i> (student work samples) Item 14</p>

Lesson 4-7: Use Properties to Multiply Decimals		
<p>5.NBT.B.7</p> <p>MP.1 MP.2 MP.6 MP.7</p>	<p>Access Prior Learning: Students have worked with the associative and commutative properties in previous grades (4.NBT.B.5) and topics.</p> <p>Developing the Big Idea: Students will develop conceptual understanding of multiplication with decimals through use of the associative and commutative properties. Important conceptual understandings are built in preparation for use of the standard algorithm to multiply decimals. Connections are made between fractions and decimals.</p>	<p>Solve and Share: Estimating will help students to use the context of the problem and think about reasonable solutions. Providing a blank hundredths grid to students will remind them that they can use visual models to multiply decimals. Look for students who use properties to break apart the decimals and multiply. If needed, project and share the student sample titled "Javier's work" provided in <i>Analyze Student Work</i> (TE, p. 201).</p> <p>Visual Learning: Several understandings need to be used together to understand the example shown. Students need to understand that decimals can be written as equivalent fractions, rewritten as a whole number times a fraction using the associative property, and that the commutative property states you can change the order of the factors. Students can utilize these properties to decompose decimal factors and use number sense to multiply.</p> <p>Assess and Differentiate: The <i>Intervention Activity</i> provides steps for using properties to multiply decimals. Use these steps as a scaffold to help students connect the different concepts being used in this lesson.</p> <p>*CTC: <i>Quick Check</i> (digital platform)</p>
Lesson 4-8: Use Number Sense to Multiply Decimals		
<p>5.NBT.B.7</p> <p>MP.1 MP.2 MP.3 MP.8</p>	<p>Access Prior Learning: In previous lessons students have multiplied whole numbers and decimals. They have also estimated products using decimals.</p> <p>Developing the Big Idea: Students will build conceptual understanding of decimal multiplication through using number sense and estimation to correctly place decimals in a product.</p>	<p>Solve and Share: The digits that make up the products of several decimal multiplication problems are given. Students will need to think about the size of the factors and reason to place the decimals in these products. Facilitate discussion around student reasoning about how factors affect the size of products.</p> <p>Visual Learning: Build on students' ideas from the <i>Solve and Share</i> to create generalizations about how the size of decimal factors can help us to place the decimal.</p> <p>Guided and Independent Practice: Ask students to connect how they might use whole number strategies to reason about decimal placement. This will build conceptual understanding of decimal multiplication and lay the groundwork for the standard multiplication algorithms. Students may choose to use whole number strategies and place the decimals using reasoning.</p>
Lesson 4-9: Multiply Decimals		
<p>5.NBT.B.7</p> <p>MP.1 MP.3 MP.6 MP.7 MP.8</p>	<p>Access Prior Learning: In previous lessons students used models and partial products strategies to multiply decimals. They have used estimation and reasoning to place the decimal in products.</p> <p>Securing the Big Idea: Students will use a standard algorithm to build procedural knowledge of multiplying decimals.</p>	<p>Solve and Share: Consider setting parameters for this <i>Solve and Share</i> such as asking students to use 0.5 as a factor for a portion of their created problems. This will help to keep the discussion focused. Students should notice that there are several ways to find the product of two decimals which includes using whole numbers and then reasoning about the numbers or counting the number of decimal places in the factors.</p> <p>Visual Learning: The U.S. traditional algorithm is shown using decimal factors. Estimating a reasonable answer before calculating will help students to remember to use reasoning and number sense as they also learn the procedure of counting decimal places in the factors to place the decimal. In <i>Another Example</i>, the U.S. traditional algorithm is used to explicitly model the problem. Students are shown to count decimal places in the factors after using the same algorithm with whole numbers. Avoid showing any rules until you are confident that students have the conceptual understanding to know why they work.</p>
Lesson 4-10: Math Practices and Problem Solving- Model with Math		
<p>5.NBT.B.7</p> <p>MP.1 MP.2 MP.4 MP.6</p>	<p>Access Prior Learning: Students have worked to represent real world contexts using mathematical expressions in previous grades.</p> <p>Securing the Big Idea: Students will select and use a model to practice the application of multiplying decimals given a real world context.</p>	<p>Solve and Share: Models used to represent this problem may be visual models or numerical expressions. Ask students to explain how their models represent the context of the problem. Share students' models and facilitate a discussion about how different models are useful for analyzing and solving problems. Facilitate a discussion about how using models promotes the habits that make a good problem solver.</p> <p>Visual Learning: Discuss how the numerical model represents the context of the problem. Students have a chance to work with a similar context in the <i>Convince Me!</i> where they will analyze how the steps in the equation match the problem (mathematical modeling). Focus on the habits of mind of problem solvers. Reinforce how to create models that represent the context of a problem during the <i>Guided Practice</i>.</p>

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		Assess and Differentiate: The <i>Intervention</i> Activity calls for students to use play money as a scaffold to model a mathematical situation. Consider using a manipulative or tool throughout all components of this lesson to build conceptual understanding.
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References

- Council of Chief State School Officers. (2010). The Nevada Academic Content Standards. Retrieved from http://www.doe.nv.gov/uploadedFiles/nde.doe.nv.gov/content/Standards_Instructional_Support/Nevada_Academic_Standards/Math_Documents/mathstandards.pdf.
- Van De Walle, J. A., Bay-Williams, J. M., Lovin, L. H., & Karp, K. S. (2014). *Teaching student-centered mathematics: Developmentally appropriate instruction for grades 6-8* (2nd ed.). New York, NY: Pearson.
- Van de Walle, J.A., Karp, K.S., & Bay-Williams, J.M. (2016). *Elementary and middle school mathematics: Teaching developmentally*. Boston: Pearson.