Grade 6
Mathematics
Unit 5: Operating with Decimals

Time Frame: Approximately three weeks

Unit Description

The focus of this unit is on developing fluency in addition, subtraction, multiplication and division of decimals. Real-world applications of decimals will be emphasized.

Student Understandings

Students fluently perform the operations of addition, subtraction, multiplication, and division on decimals and use various strategies to solve real-world problems involving decimals.

Guiding Questions

1. Can students fluently add, subtract, multiply and divide decimals using standard algorithms?
2. Can students apply real-life situations to decimal operations?
3. Can students use models to multiply decimals?
4. Can students identify and calculate a unit rate?

Unit 5 Grade-Level Expectations (GLEs) and Common Core State Standards (CCSS)

Grade-Level Expectations	
GLE #	**GLE Text and Benchmarks**
Number and Number Relations	
20.	Calculate, interpret, and compare rates such as $/lb., mpg, and mph (M-1-M) (A-5-M)
CCSS for Mathematical Content	
CCSS #	**CCSS Text**
The Number System	
6.NS.2	Fluently divide multi-digit numbers using the standard algorithm.
6.NS.3	Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
ELA CCSS	
Reading Standards for Literacy in Science and Technical Subjects 6–12	
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

Sample Activities

Activity 1: Adding and Subtracting Decimals (CCSS: 6.NS.3)

Materials List: Graph Paper BLM, Decimal Operations BLM, calculators, pencil

Have students use calculators to solve the following addition and subtraction problems with decimals:

4.1 + 3.09 57.03 + 4.675 5 – 4.01 8.09 – 3.3

Ask them to look for patterns in the problems so that they can develop their own algorithms for solving these types of problems.

Distribute the Graph Paper BLM to help students line up the decimals. These steps are some that students may discover for adding and subtracting decimals.

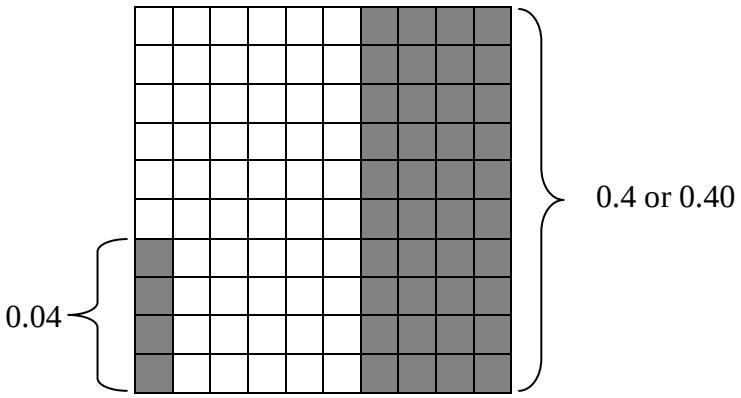
Step 1: Write the numbers one under the other with the decimal points lined up. Make sure the first number is on top and the second number is on the bottom.

- Ask students, "Why is it important to line up the decimal points?"

Step 2: Add zeros to the end of the number so the numbers have the same number of digits behind the decimal.

Discuss the following questions.

- Does changing 0.4 to 0.40 change the value of the number? *No, you can add any number of zeros to the end of a number behind a decimal and not change the value of a the decimal*
- Does changing 0.4 to 0.04 change the value of the number? *Yes* Have students draw a 10 by 10 grid on their graph paper. Have students shade in four tenths and shade in four hundredths to see if they name the same amount. *0.4 or four tenths is not the same as 0.04 or four hundredths. Four tenths is larger.*



Step 3: Add or subtract and bring the decimal straight down.

Give students the following problems.

5.13 + 12.4 = ? 52.4 – 7.31 = ?

Have them use the grid paper to line up the numbers. Have them add or subtract to find the answers using all the rules above.

		5	.	1	3
+	1	2	.	4	0
	1	7	.	5	3

5	2	.	4	0
-	7	.	3	1
4	5	.	0	9

After several examples have been explored and the students can correctly state and explain an algorithm, distribute the Decimal Operations BLM for students to solve without using calculators. Stress the importance of first solving by mental math to arrive at an estimated answer. When students have correctly mastered the use of the algorithm of adding and subtracting (set-up problems by lining up decimals and solve as with whole numbers), continue giving them real-life situation problems to solve.

Below are websites to provide additional practice adding and subtracting decimals.

http://www.math.com/school/subject1/practice/S1U1L4/S1U1L4Pract.html
http://www.shoreline.edu/callab/GED/Decaddsub1.htm
http://www.funbrain.com/football/index.html
http://www.quia.com/rr/31090.html

Activity 2: Decimals in Daily Life (CCSS: 6.NS.3)

Materials List: newspapers or Internet access, paper, pencil

The newspaper and the Internet are good resources for applications of decimals. It may even be possible to find problems that relate to the content students are studying in other subjects. The following are a few examples:

- The weekly movie box office totals are given in decimals (for example, $27.2M for $27,200,000) in either the local paper, *USA Today*, or at http://www.usatoday.com/life/movies/news/story/2011-12-06/Weekly-box-office-chart/51653734/1. Display the Box Office Chart information. Have students make up and answer problems about the top ten movies of the week. Examples: How much more did the #1 rated movie make over the #2 or #10? How much did all top ten movies make in one week?

- Have students research various stocks and follow the changes in price for a period of one week (or longer). Have them calculate the new closing price each day. http://markets.usatoday.com/custom/usatoday-com/html-markets.asp
- Have students gather rainfall information for various cities athttp://www.wunderground.com/history. Have students find the totals for the week or month.

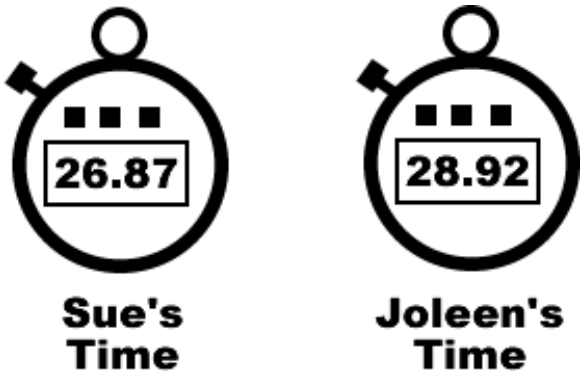
Activity 3: Real-World Decimals (CCSS: 6.NS.3)

Materials List: paper, pencil

Divide students into small groups. Use the *discussion strategy,* Think Pair Square Share (view literacy strategy descriptions) to have students create a list of a variety of real-life situations where decimals are used. Structured discussion helps improve student learning and remembering of a particular topic. Give students an issue, problem, or question, and ask them to think alone for a short period of time, and then pair up with someone to share their thoughts. Have pairs of students team up with other pairs, forming, in effect, small groups of four and further the discussion. Finally, have groups share with the whole class. Examples of real-world uses of decimals students might discuss in their groups are money, timing at track or swim meets, measuring height or depth, the price of gasoline or the number of gallons, batting averages, stock prices, football statistics, and rainfall amounts.

Select one of the examples from the list generated by the class. As a class, create a real-life problem that involves adding and subtracting decimals.
For example:

> At last week's track meet, Sue finished the 200 meter race in 26.87 seconds. Joleen finished in 28.92 seconds. Who won the race? What was the difference in their times?



	2	8	.	9	2
−	2	6	.	8	7
		2	.	0	5

Sue won the race; she finished 2.05 seconds before Joleen.

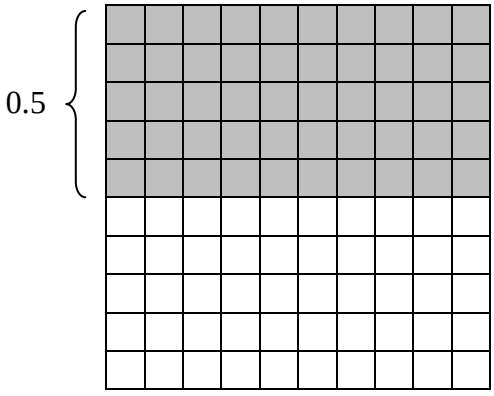
Professor know-it-all (view literacy strategy descriptions) can be used to check for understanding of decimals. Have the students work in pairs to create a word problem using a real-life situation from their list that involves adding or subtracting decimals. Each group should illustrate the problem, write a mathematical sentence that describes the situation, and solve the problem. Groups should also write at least 3-5 peer anticipated questions and 2-5 questions to ask other experts. Remind students they must be ready to defend the reasonableness of their problems, thought processes, and solutions to the class. After students have been given time to complete their problems, choose groups at random to assume the role of *professor know-it-all* by taking positions in front of the class and presenting their real-life word problems adding or subtracting decimals. The other students should hold the professors accountable for accuracy and logic. They should also be encouraged to ask the questions they prepared for the professors and ensure their answers are logical and accurate. After five minutes or so, send another group to the front of the room and repeat the process. Be sure all groups get an opportunity to be the professor.

Activity 4: Modeling Multiplying Decimals (CCSS: 6.NS.3)

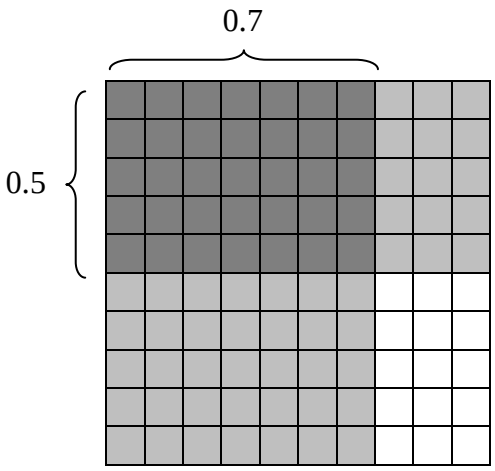
Materials List: Hundredths Square BLM, Modeling Multiplying Decimals BLM, Multiplying Decimals BLM, calculators, paper, pencil

Distribute the Hundredths Square BLM to the students and display a hundredths square.

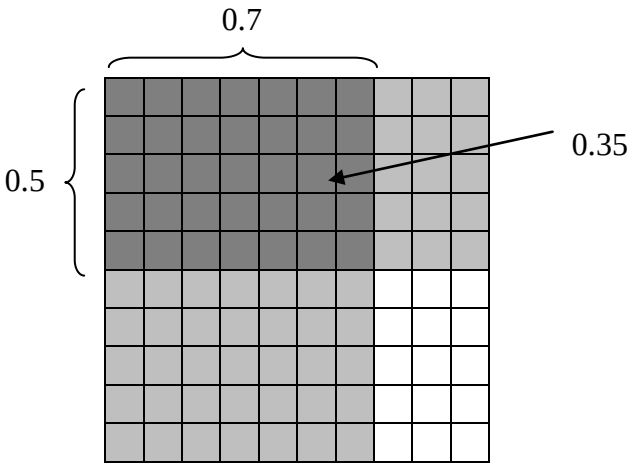
Have students shade in 0.5 horizontally on their hundredths square.



Have students shade in 0.7 vertically on the same hundredths grid.



The squares that receive the double shading are the product, thirty-five hundredths or 0.35. The hundredths square shown below represents the problem 0.5 × 0.7 = 0.35



0.5 × 0.7 = 0.35

Distribute the Modeling Multiplying Decimals BLM. Work problems 1 and 2 together as a class. Have students complete problems 3 and 4. After students have finished 3 and 4, have volunteers model and explain their solutions.

Have students examine the modeled problems and lead them to see that each time they multiplied, the product had 2 digits behind the decimal. Because 0.5 had 1 digit behind the decimal and 0.7 had 1 digit behind the decimal, the product must have 2 digits behind the decimal.

Display 0.23 × 0.3. Have students predict the number of decimal places in the product.

Ask the following questions:

How many digits are behind the decimal in 0.23? *2 digits*

How many digits are behind the decimal in 0.3? *1 digit*

Have students multiply 0.23×0.3 using a calculator. $0.23 \times 0.3 = 0.069$
Compare the number of decimal places in the product to the predictions.

Display 0.5×0.6. Have students predict the number of decimal places in the product.
Have students check their predictions on a calculator. The calculator will show only 1 digit after the decimal place. It will show a product of 0.3 instead of 0.30. Ask students why they think the calculator shows 0.3 instead of 0.30. Discuss that 0.3 and 0.30 name the same amount. The calculator automatically drops zeros at the end of a number behind the decimal. This is the same as dropping the zeros when simplifying fractions. $\frac{30}{100} = \frac{3}{10}$

Tell students that when they multiply two decimals, they should multiply the numbers and can ignore the decimals. To place the decimal point, they have to find the sum of the number of digits behind the decimal in each factor. The product has the same number of digits behind the decimal in it. Work the following problems as a class.

1. 2.03×0.3

   Predict the number of decimal places in the product. Multiply the numbers.

$$\begin{array}{r} 2.03 \\ \times\ 0.3 \\ \hline 0.609 \end{array}$$

2. 1.22×2.4

   Predict the number of decimal places in the product. Multiply the numbers.

$$\begin{array}{r} 1.22 \\ \times\ 2.4 \\ \hline 488 \\ +\ 2440 \\ \hline 2.928 \end{array}$$

Distribute the Multiplying Decimals BLM. Have students work in pairs to solve the problems. Discuss the solutions as a class.

Activity 5: Big Spender (CCSS: 6.NS.3)

Materials List: Spinner BLM, Big Spender Cards BLM, Big Spender Record BLM, calculator, paper, pencil, scissors, paper clip to use as a spinner

Before beginning the lesson, copy a Spinner BLM and a set of Big Spender Cards for each group of students and a Big Spender Record BLM for each student. Cut out the spinners and Big Spender Cards prior to the lesson or provide students scissors to cut them.

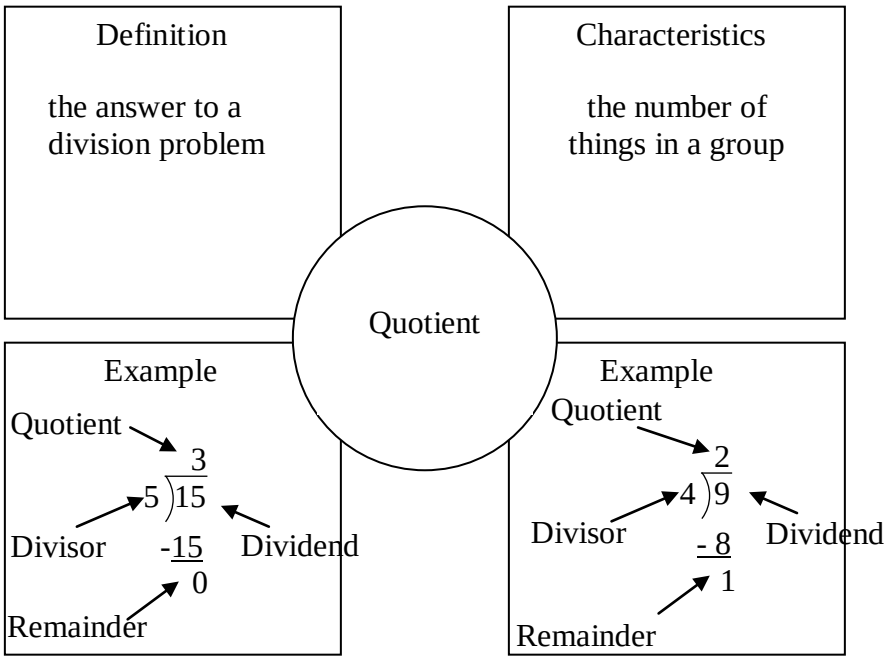
Divide the students into pairs and distribute the spinners and Big Spender Cards. Have students take turns spinning the spinner and selecting a card from the pile. The spinner tells the number of items purchased and the card shows the price. After the student spins a number on the spinner, he/she must multiply that number by the amount on the card and record it on the Big Spender Record BLM. Partners will use calculators to check the products for accuracy. The partner who spends the most money after all cards are used is the Big Spender.

Activity 6: Dividing Decimals (CCSS: 6.NS.2; 6.NS.3 RST.6-8.4)

Materials List: index cards, Dividing Decimals BLM, calculators, paper, pencil

To develop students' knowledge of key vocabulary, have them create *vocabulary cards* (view literacy strategy descriptions) to define divisor, dividend and quotient. Distribute 3×5 or 5×7 inch index cards to each student. Have students place the targeted word in the middle of the card, as in the example that follows. Have students work together in groups to define the term. Discuss the definitions as a class and select the one that best defines the word. Have each student write the definition in the appropriate space. Have students list the characteristics or description, give two examples.

Have students punch a hole in each card and add the cards to their cards made in previous units. Allow time for students to review their cards and quiz partners on the terms to hold them accountable for accurate information on the cards. This type of review will prepare students for other class activities and quizzes related to content on divisor, dividend, and quotient.



Display the following problem: 30 ÷ 6.
Have students explore what happens when two numbers, the dividend and the divisor, are multiplied by the same power of 10. Have students use a calculator to find the quotient when both the dividend and divisor are multiplied by 10.

Ask the following:

- What is 30 ÷ 6? *5*
- What is 30 × 10? *300*
- What is 6 × 10? *60*
- What is 300 ÷ 60? *5*
- What happened to the quotient? *It stayed the same. It is still 5.*

Multiply both the dividend and divisor by 100.

- What happened to the quotient? *Again, it stayed the same. 3000 ÷ 600 = 5.*

Multiply both the dividend and divisor by 0.01

- What do you think the quotient will be? *It will stay the same. 0.3 ÷ 0.06 = 5.*

Have students use calculators to check their predictions about the quotients. Ask students to generalize a rule about what was just done. Students should discover that if they multiply the dividend and the divisor by the same number, the relationship between the two quantities stays the same. This relationship becomes very important when dividing by decimals. It will allow students to change the divisor to a whole number.

Have students explain the process of dividing decimals in a modified *split-page notetaking* (view literacy strategy descriptions) format. Model the approach by displaying an example of how to set up their papers for *split-page notetaking* similar to the example below. Explain the value of taking notes in this format by saying it logically organizes information and ideas; it helps separate big ideas from supporting details; and it makes review and study more efficient.

Tell students to draw a vertical line approximately 2 to 3 inches from the left edge on a sheet of notepaper. They should try to split the page into one third and two thirds. Have students write the steps in words on the left side and the algorithm on the right side. Continue to periodically model and guide students as they use *split-page notetaking* and increase their effectiveness with this technique. Demonstrate how students can study from their notes by covering one column and using the other column try to recall the covered information. Assessments should include information that students recorded in their *split-page notes.* In this way, they will see the connection between the taking notes in this format and achievement on quizzes and tests.

Problem:	13.86 ÷ 2.2
Set up your problem.	13.86 is the dividend and 2.2 is the divisor $2.2\overline{)13.86}$
Change the divisor into a whole number.	Ask students, "If you want to divide using a whole number, by what number should you multiply 2.2?" *(10)* "If you multiply 2.2 by 10, what else do you need to do to maintain the relationship between the divisor and the dividend?" *Multiply the dividend by 10.* "What would happen if you multiplied the dividend and divisor by 100 instead?" *The quotient would remain the same.* Have students multiply both the divisor and the dividend by the same power of ten. In this example, multiply them both by 10. $22\overline{)138.6}$
Divide the numbers as with whole numbers.	$22\overline{)1386}$ 63 -132 ↓ 66 -66 0

Put the decimal directly above the decimal point in the dividend.	Have students use a calculator to check the problem. Ask, "Where does the decimal go?" *To the right of the 6.* Ask, "How does that placement relate to the algorithm?" *It is directly above the placement of the decimal in the dividend* 13.86 ÷ 2.2 = 6.3

Distribute the Dividing Decimals BLM. Work problems 1 and 2 together as a class. Have students complete the rest of the problems independently or with partners. After students have completed the problems, discuss the solutions as a class.

Activity 7: Just One Please (GLEs: 20; CCSS: 6.NS.2; 6.NS.3)

Materials List: weekly ads, calculators, paper, pencil

Bring several weekly ads from various grocery stores and department stores or have students bring them in. Have students use the ads to find items that are packed in multiples instead of individually. For example: soft drinks, paper towels, granola bars, batteries, pens. Have students determine the price of a single item (unit price). If they find similar items at different stores, have them decide which place has the best buy. Have students use calculators to check for accuracy. Have volunteers share their results with the class.

Have students work with partners to plan a party for their class. Using the weekly ads, have students select what they will serve and how much of each item will be needed. Have students calculate the cost of the party and present their information to the class.

Activity 8: Menu Math (6.NS.2; 6.NS.3)

Materials List: menus from a restaurant or Menu BLM, Bill BLM, calculators, paper, pencil

Old restaurant menus make a great teaching tool. Restaurants frequently update their menus and most will gladly give a set for use in the classroom.

Distribute menus or the Menu BLM and the Bill BLM to students. Present the following problem.

You and 3 of your friends are going out to eat. You have $75 to spend and you must order at least one appetizer and an entrée and drink for each person.

1. Record what you will order and calculate how much the bill is before tax and tip?

2. If tax is 8%, how much will the bill be including tax? (Hint: Multiply the amount of the bill times 0.8 then add the amount to the total.)
3. If you want to leave a 20% tip, how much extra should you pay? Do you still have enough money? (Hint: Multiply the amount of the bill times 0.2 (or multiply by 0.1 and double that amount) and add the amount to the total.)

4. If you and your friends decide to split the bill evenly, how much will each person pay?

5. How much money will you have left?

Have students check each other's bills for accuracy.

Sample Assessments

General Assessments

- Have the student create a portfolio containing samples of experiments and activities.
- Have the student give real-life examples of using decimals (purchase of gasoline shopping for loose vegetables and fruit, and keeping and interpreting sports statistics).
- Have the student create and demonstrate original math problems by acting them out or using manipulatives to provide solutions.
- Facilitate during small group discussion to determine misconceptions, understandings, use of correct terminology, and reasoning abilities. Ask appropriate questions to encourage reflection as students develop algorithms for addition, subtractions, multiplication and division of decimals such as the following:
    - How did you get your answer?
    - Does your answer seem reasonable? Why or why not?
    - Can you describe your method to us all? Can you explain why it works?
    - What if you had started with… rather than…?
    - What if you could only use…?
    - What have you learned or found out today?
    - Did you use or learn any new words today? What do they mean? How do you spell them?
- Ask probing questions to help students build confidence in their reasoning, such as…
    - Why is that true?
    - How did you reach that conclusion?
    - Does that make sense?
    - Can you make a model to show that?
- Have students create journal writings using such topics as:
    - The most important thing I learned in math this week was…
    - The easiest thing about today's lesson was…

Activity-Specific Assessments

- Activity 1: Have students write real-life addition and subtraction problems with decimals. Have students solve the problem and explain their solutions.

- Activity 4: Have students select the correct answer from those listed and explain their reasoning.

  6.14×3.2

  a. 1.9648
  b. 19.648
  c. 196.48
  d. 1964.8

- Activity 8: Distribute the Menu BLM. Have students calculate the bill for the following order. Include tax at 9% and a tip at 20%
  Nachos
  Tacos
  Burrito
  2 Soft Drinks
  Cheesecake

Answer: The total cost of the meal including tax and tip is $43.37.

Name of Food	***$***
Nachos	***6.65***
Tacos	***8.49***
Burrito	***9.49***
Soft drinks (2)	***3.18***
Cheesecake	***5.35***
Subtotal	***33.16***
Tax – 9%	***2.98***
Total of meal	***36.14***
20% tip	***7.23***