Multiplying and Dividing Decimals – ALPHA VERSION OCTOBER 2012

Grade 5

Mathematics Formative Assessment Lesson

Designed by Kentucky Department of Education Mathematics Specialists to be Field-tested by Kentucky Mathematics Leadership Network Teachers

If you encounter errors or other issues, please contact the KDE team at:

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Created for the sole purpose of assisting teachers as they develop student understanding of Kentucky’s Core Academic Standard through the use of highly effective teaching and learning.

Not intended for sale.
Multiplying and Dividing Decimals

Mathematical goals

This lesson is intended to help you assess how well students understand the result of multiplying and dividing by a decimal less than and greater than one and what strategies they use to perform these operations. It will help you to identify students who have the following difficulties:

- Lack of conceptual understanding of the properties of numbers
- Do not see the relationship between multiplication and division
- Applying efficient strategies to multiply and divide with decimals to hundredths.

Common Core State Standards

This lesson involves mathematical content in the standards from across the grades, with emphasis on:

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

This lesson involves a range of Standards for Mathematical Practice, with emphasis on:

2. Reason abstractly and quantitatively.

Introduction

This lesson is structured in the following way:

- Before the lesson, students work individually on an assessment task that is designed to reveal their current understandings and difficulties. You then review their work and create questions for students to answer in order to improve their solutions.
- Students work in small groups (partners/pairs) on collaborative discussion tasks to multiply, divide and subtract problems involving decimals. Throughout their work, students justify and explain their decisions to their peers.
- Students return to their original assessment tasks, and try to improve their own responses.
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Materials Required

Each pair of students will need:

- Card Sets (Each set printed on different colored paper/cardstock will be helpful.)
- Recording Sheet
- Grid paper
- Base ten blocks
- Calculator for checking

Time needed

Approximately 15 minutes before the lesson (for the individual assessment task), one 40 minute lesson (30 minutes for group task and 10 minutes for whole class discussion), and 15 minutes for a follow-up lesson (for students to revisit individual assessment task). Timings given are only approximate. Exact timings will depend on the needs of the class. All students need not finish all card sets to complete the lesson.

Before the Lesson

Assessment task: Operations with Decimals (15 minutes)

Framing the task:

*Today we will work on a task to see how well you are able to solve multiplication and division problems involving decimals. Explain thinking on the lines provided. You will have 15 minutes to work independently on the task “Operations with Decimals.” After 15 I will collect your papers and see how you solved and explained problems.*

Have students do this task individually in class a day or more before the formative assessment lesson. This will give you an opportunity to assess the and to find out the kinds of difficulties students have. You will be able to your help more effectively in the follow-up lesson.

Give each student a copy of the assessment. Students should use the strategies know to calculate the problems.

It is important that the students are allowed to answer the questions without your assistance or use of manipulative or a calculator. The intention is for students to use their knowledge of multiplication and division and their reasoning skills to determine the answer to the problem.

Students should not worry too much if they do not understand or do everything, because in the next lesson they will engage in a similar task, which should help them. Explain to students that by the end of the next lesson, they should expect to answer questions such as these confidently. This is their goal.

Assessing Students’ Responses

Collect students’ responses to the task. Make some notes about what their work reveals about their current levels of understanding, and their different problem solving approaches.
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We suggest that you do not score students’ work. The research shows that this will be counterproductive, as it will encourage students to compare their scores, and will distract their attention from what they can do to improve their mathematics.

Instead, help students to make further progress by summarizing their difficulties as a series of questions. Some questions on the following page may serve as examples. These questions have been drawn from commonly identified student misconceptions. These can be written on the board at the end of the lesson before students revisit the initial task.

We suggest that you write a list of your own questions, based on your students’ work, using the ideas that follow. You may choose to write questions on each student’s work. If you do not have time to do this, select a few questions that will be of help to the majority of students. These can be written on the board at the end of the lesson.

Below is a list of common issues and questions/prompts that may be written on individual initial tasks or during the collaborative activity to help students clarify and extend their thinking.

**Common issues: Suggested questions and prompts:**

<table>
<thead>
<tr>
<th>Common Issues:</th>
<th>Suggested Questions and Prompts:</th>
</tr>
</thead>
<tbody>
<tr>
<td>When multiplying by a number, students assume the answer must get larger.</td>
<td>• <em>What happens to a number when you multiply by a fraction?</em></td>
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<tr>
<td></td>
<td>• <em>How does a decimal relate to a fraction?</em></td>
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<td></td>
<td>• <em>Is the decimal a part, a whole or a part and a whole? What will that do to the result?</em></td>
</tr>
<tr>
<td>When dividing by a number, students assume the answer must get smaller.</td>
<td>• *Divide a dollar into quarters. What is the result? Did the result increase or decrease? Why?</td>
</tr>
<tr>
<td></td>
<td>• <em>Is the decimal a part, a whole or a part and a whole? What will that do to the result?</em></td>
</tr>
<tr>
<td>Students use the standard algorithm instead of estimating and are unable to demonstrate conceptual knowledge.</td>
<td>• <em>Are you able to estimate the number to a benchmark?</em></td>
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<tr>
<td></td>
<td>• *Can you think of the number as a fraction? What would you do if you were estimating a fraction?</td>
</tr>
</tbody>
</table>
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Suggested Lesson Outline

Improve individual solutions to the assessment task (10 minutes)

Return your students’ work on the *Operations with Decimals* problems. Ask students to re-read both the *Operations with Decimals* problems and their solutions. If you have not added questions to students’ work, write a short list of your most common questions on the board. Students can then select a few questions appropriate to their own work and begin answering them.

*Recall what we were working on previously. What was the task?*

Draw students’ attention to the questions you have written.

*I have read your solutions and I have some questions about your work.*

*I would like you to work on your own to answer my questions for ten minutes.*

Collaborative Activity: Decimal War

Homogeneously group students based on the results of the pre-assessment. Groups should consist of two or four students. Within groups of four, students will need to work in pairs. With larger groups, some students may not fully engage in the task.

Framing the Collaborative Activity:

Card Set A (*Whole numbers*)

Introduce the lesson carefully:

*Today we will work on an activity to help understand multiplying and dividing decimals. You will work with a partner. Each team member will have a set of cards. Each person will turn over one card from their deck. Player A will estimate the product of the two cards and record the estimate on the record sheet. Player B will estimate the quotient of the two cards and record the estimate on the record sheet. After each player has recorded their estimate, Player A will do a calculator check for Player’s B problem and record the actual quotient. Player B will do the same for Player A’s problem. Each player will then find the difference between their estimate and actual answer. The player with the least difference wins that round and collects those cards. For each round, explain your thinking clearly to your partner describing how you estimated your answer. If your partner disagrees with your total, challenge him or her to explain why. It is important that you both understand how each answer was figured. Circle the largest sum. Continue this procedure for 6 rounds.*

*There is a lot of work to do today and you may not all finish all of the rounds. The important thing is to learn something new, so take your time.*

Levels advance by difficulty (Card Set A: Whole numbers) (Card Set B: Benchmark decimals less than and greater than 1) (Card Set C: Same set as set B. Allows both students to have card set B for the same round) (Card Set D: Decimals that students will need to estimate to benchmarks before performing the operation).

Your tasks during the small group work are to make a note of student approaches to the task, and to support student problem solving.

Give each group Card Set A and Card Set B to begin and a recording sheet. Copy the recording sheet on both sides of the paper so students can go through the rounds several times as time allows.
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**Make a note of student approaches to the task**

You can then use this information to focus a whole-class discussion towards the end of the lesson. In particular, notice any common mistakes. Partners should be engaged in checking their partner, asking for clarification, and taking turns. When calling on students make sure you allow the struggling groups to share first.

**Support student problem solving**

Try not to make suggestions that move students toward a particular approach to the task. Instead, ask questions to help students clarify their thinking. Encourage students to use each other as a resource for learning.

If one student has multiplied or divided in a particular way, challenge their partner to provide an explanation.

If you find students have difficulty articulating their decisions, then you may want to use the questions from the *Common Issues* table to support your questioning.

If the whole class is struggling on the same issue, then you may want to write a couple of questions on the board and organize a whole class discussion.

This task is designed for students to use their understanding of multiplying and dividing numbers with decimals that they have developed during the unit of instruction. Manipulatives should be made available to each group to help use.

**Card Set C (Card Set C: Benchmark decimal numbers—repeat of Card Set B)**

As students finish working with card sets A and B and are able to explain their reasoning, hand out Card Set C and remove Card Set A. Because both players will have decimal numbers, these will be more difficult. You may want to instruct the players to switch whether they are player A or B so that they can practice with multiplication or division. If a partner group is not ready to move to Card Sets B and C, have them repeat with sets A and B but changing the player roles (Player A to B--instruct them to shuffle the cards though).

As you monitor the work, listen to the discussion and help students to look for patterns and generalizations. Make note of strategies you want students to share in the follow-up discussion.

**Card Set D (Card Set D: Decimal numbers that will need to be rounded to a benchmark number)**

As students finish with Card Set C and are able to explain their reasoning, hand out Card Set D. Students will now be challenged to multiply and divide by decimal numbers that are not benchmarks. When using Card Set D, you may want the other partner to start with Card Set A (whole numbers) to help the group develop strategies with the non-benchmark decimal numbers before having the pair work with Card Sets C and D.

As students finish the 6 rounds, they may go back, shuffle and replay.

**Sharing Work (10 minutes)**

Students can share aloud some strategies they used to estimate their products and quotients.

**Extension activities**

Extension 1: Challenge those students who complete all card sets to play another game changing the roles (Player A to Player B).

Extension 2: Challenge students to represent or draw a visual model of the problem and actual answer from one of the rounds. (5.NBT.7)
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**Plenary whole-class discussion (10 minutes)**

Conclude the lesson by discussing and generalizing what has been learned. Students sharing the strategies they used aloud will be valuable to the learning of the group. The generalization involves extending what has been learned to new examples.

**Improving individual solutions to the assessment task (10 minutes)**

Return the initial task, *Operations with Decimals*, to students as well as a second blank copy of the task.

*Look at your original responses and think about what you have learned during this lesson. Using what you have learned, try to improve your work.*

If you have not added feedback questions to individual pieces of work then write your list of questions on the board. Students should select from this list only the questions appropriate to their own work.
### Operations with Decimals *(Solution)*

**Name __________________**

**ESTIMATE** the product or quotient to the following problems. Explain your thinking.

| A. | 4 x 0.75 | Explain your thinking.  
3—If I have 4 sets of 75 cents, then I have $3.  
3.20—If I round 0.75 to 0.8 and multiply 4 x 8, then I have 32. I have to put the decimal back in to get 3.2 |
| --- | --- | --- |
| B. | 4 ÷ 0.65 | Explain your thinking.  
6—If I round 0.65 to 0.70 and I think if I have $4 how many .70 cents are in the $4. |
| C. | 2.8 x 1.42 | Explain your thinking.  
4.2—I rounded 2.8 to 3 and 1.42 to 1.4. 3 x 1 =3 and 3 x 0.4=1.2 so 3+1.2=4.2  
4.2—I rounded 1.42 to 1.5. 2.8x1.5. 2.8 x 1=2.8 and half of 2.8 = 1.4. 1.4+2.8=4.2 |
| D. | 2.75 ÷ 1.30 | Explain your thinking.  
2—Thinking of money—how many $1.30’s are there in $2.75 = 2 with 15 cents left over |
ESTIMATE the product or quotient to the following problems. Explain your thinking.

A. $4 \times 0.75$

B. $4 \div 0.65$

C. $2.8 \times 1.42$

D. $2.75 \div 1.30$
Decimal War Record Sheet

Name_______________________

Give each player a set of cards placed faced down. Each player will turn over one card at the same time. Player A will estimate the product of the two cards and record the answer. Player B will estimate the quotient of the two cards and record the answer. After each player has estimated their answer, Player A can use a calculator to record the actual answer for Player B’s problem. Player B must subtract the estimate and actual answer. Player B will do the same calculator check for Player A. The player with the least difference wins that round and collects the cards. The player with the most cards at the end of 6 rounds, wins that game. After completing 6 rounds, change one of the card sets and play again.

<table>
<thead>
<tr>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
<th>Round 4</th>
<th>Round 5</th>
<th>Round 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card 1</td>
<td>Card 2</td>
<td>Estimated Product</td>
<td>Actual Product</td>
<td>Difference</td>
<td>Estimated Quotient</td>
</tr>
<tr>
<td>Player A</td>
<td>Player B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Card Set A

4 14
Card Set A  Card Set A

8 19
Card Set A  Card Set A

24 10
Card Set A  Card Set A
<table>
<thead>
<tr>
<th>Card Set B</th>
<th>Card Set B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>0.5</td>
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<tr>
<td>1.25</td>
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<td>2.25</td>
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<tr>
<td>Card Set C</td>
<td>Card Set C</td>
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<tr>
<td>1.25</td>
<td>1.50</td>
</tr>
<tr>
<td>Card Set C</td>
<td>Card Set C</td>
</tr>
<tr>
<td>2.25</td>
<td>0.75</td>
</tr>
<tr>
<td>Card Set C</td>
<td>Card Set C</td>
</tr>
<tr>
<td>Card Set D</td>
<td>Card Set D</td>
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<tr>
<td>0.56</td>
<td>0.98</td>
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<td>1.12</td>
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<td>1.95</td>
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