



Number and Operations in Base Ten

Multiplication and Division with Decimals

Grade 5

Formative Assessment Lesson

Designed and revised by the Kentucky Department of Education
Field-tested by Kentucky Mathematics Leadership Network Teachers

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Multiplication and Division with Decimals Grade 5

This Formative Assessment Lesson is designed to be part of an instructional unit. This task should be implemented approximately two-thirds of the way through the instructional unit. The results of this task should then be used to inform the instruction that will take place for the remainder of your unit.

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.

Kentucky Academic Standards

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

Number and Operations in Base Ten

5.NBT.7

- 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

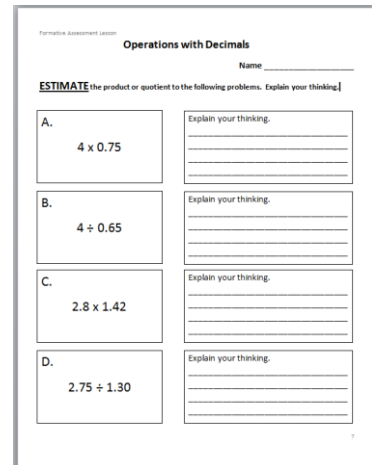
This lesson is structured in the following way:

- A day or two 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.
- A whole class introduction provides students with guidance on how to engage with the content of the task.
- Students work in small groups (pairs or threes) on a collaborative discussion task to help understand multiplying and dividing decimals. As they do this, they interpret the cards' meanings and begin to link them together. Throughout their work, students justify and explain their decisions to their peers and teacher(s).
- In a final whole class discussion, students synthesize and reflect on the learning to make connections within the content of the lesson.
- Finally, students revisit their original work or a similar task, and try to improve their individual responses.

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



Formative Assessment Lesson

Operations with Decimals

Name _____

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

| | |
|-------------------------|---|
| A. 4×0.75 | Explain your thinking. _____ _____ _____ |
| B. $4 \div 0.65$ | Explain your thinking. _____ _____ _____ |
| C. 2.8×1.42 | Explain your thinking. _____ _____ _____ |
| D. $2.75 \div 1.30$ | Explain your thinking. _____ _____ _____ |

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 your thinking on the lines provided. You will have 15 minutes to work independently on the task "Operations with Decimals." After 15 minutes I will collect your papers and see how you solved and explained your 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 work, and to find out the kinds of difficulties students have. You will be able to target your help more effectively in the follow-up lesson.

Give each student a copy of the assessment. Students should use the strategies they 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 cannot complete 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.

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/displayed 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: |
|---|--|
| When multiplying by a number, students assume the answer must get larger. | What happens to a number when you multiply by a fraction? How does a decimal relate to a fraction? |
| When dividing by a number, students assume the answer must get smaller. | Divide a dollar into quarters. What is the result? Did the result increase or decrease? Why? |
| Students use the standard algorithm instead of estimating and are unable to demonstrate conceptual knowledge. | Are you able to estimate the number to a benchmark? |
| | |
| | |

Suggested Lesson Outline

Whole class introduction (10 minutes)

Each student should have white board, marker, and eraser Begin by writing 21 and 9 on the board.

Say: Estimate the product of 21 and 9 and explain your thinking on your white board. Share your estimate and strategy with your partner.

Strategically select students to share their strategies aloud with whole group.

Say: Now estimate the quotient of 21 and 9 and explain your thinking on your white board. Share your estimate and strategy with your partner.

Strategically select students to share their strategies aloud with whole group.

Say: Estimate the product of 13 and 0.5 and explain your thinking on your white board. Share your estimate and strategy with your partner.

Strategically select students to share their strategies aloud with whole group.

Say: Now estimate the quotient of 13 and 0.5 and explain your thinking on your white board. Share your estimate and strategy with your partner.

Strategically select students to share their strategies aloud with whole group.

Collaborative Activity: Decimal War

Strategically group students based on pre assessment data into groups of two or three students. With larger groups, some students may not fully engage in the task. Consider grouping students who were very successful together, those who did fairly well together, and those who did not do very well together. While this may seem counterintuitive, this will allow each student to more confidently share their thinking.

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 card 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 B's 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 notes of student approaches to the task, and to support student problem solving.

Give each partner 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.

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 may 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)

Whole-class discussion (10 minutes)

Conduct a whole-class discussion about what has been learned and highlight misconceptions and strategies you want to be revealed. Select students or groups who demonstrated strategies and misconceptions you want to share with the class. Be intentional about the order of student sharing from least complex to most complex thinking. As each group shares, highlight the connections between strategies.

Possible questions to ask: How does student A's strategy connect to student B's strategy?

Conclude the lesson by discussing and generalizing what has been learned. The generalization involves first extending what has been learned to new examples, and then examining some of the conclusions the students come up with.

Ask: *Which cards were easiest/hardest to match? Why?
What might be a different way to explain?
Did anyone do the same or something different?
How would you explain your model in words ?*

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.

This lesson format was designed from the Classroom Challenge Lessons intended for students in grades 6 through 12 from the [Math Assessment Project](#).

Operations with Decimals

Name _____

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

A.

$$4 \times 0.75$$

Explain your thinking.

B.

$$4 \div 0.65$$

Explain your thinking.

C.

$$2.8 \times 1.42$$

Explain your thinking.

D.

$$2.75 \div 1.30$$

Explain your thinking.

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.

| Player A | | | | | | Player B | | |
|-----------------|--------|--------|-------------------|----------------|------------|--------------------|-----------------|------------|
| | Card 1 | Card 2 | Estimated Product | Actual Product | Difference | Estimated Quotient | Actual Quotient | Difference |
| Round 1 | | | | | | | | |
| Round 2 | | | | | | | | |
| Round 3 | | | | | | | | |
| Round 4 | | | | | | | | |
| Round 5 | | | | | | | | |
| Round 6 | | | | | | | | |

Card Set A

4

Card Set A

14

Card Set A

8

Card Set A

19

Card Set A

24

Card Set A

10

Card Set A

Card Set B

0.25

Card Set B

0.5

Card Set B

1.25

Card Set B

1.50

Card Set B

2.25

Card Set B

0.75

Card Set B

Card Set C (Repeat Set B)

0.25

Card Set C

0.5

Card Set C

1.25

Card Set C

1.50

Card Set C

2.25

Card Set C

0.75

Card Set C

Card Set D

0.56

Card Set D

0.98

Card Set D

1.12

Card Set D

1.44

Card Set D

1.95

Card Set D

0.41

Card Set D