Teacher's Guide: Multiplying Fractions by Whole Numbers: Recipes

Recommended Grade Level: 5-8
(also applicable to grades 9-12 for students requiring significant support in learning)

Suggested Time: About 50-60 minutes spread over one or more class periods, plus additional time to complete a writing assignment

Goals

Following are the big ideas that students should take away after completing this lesson:

- Multiplication and addition are related.
- A math model can be used to understand math problems.
- Multiplication of a whole number and a fraction follows certain rules.

Vocabulary
(See definitions on page 6.)

- denominator
- double
- fraction
- model
- numerator
- product
- triple

Key Literacy Strategies

Following are the primary literacy strategies students will use to complete this activity:

- Determining important information (screens 4, 5, 6, 7, 8, and 9; final assignments 1 and 3)
- Making inferences (screen 7)
- Categorizing basic facts and ideas (screen 12)
- Identifying and using text features (final assignment 3)

Note: In addition to the key literacy strategies listed above, students will also use each of these strategies to complete this lesson:

- Monitoring comprehension
- Synthesizing
- Making predictions
- Developing vocabulary
- Connecting prior knowledge to new learning
- Developing a topic in writing
- Identifying and using text features (photographs, captions, diagrams, and/or maps)

Overview

Multiplying Fractions by Whole Numbers: Recipes is a student-directed learning experience. However, while students are expected to work through the lesson on their own, teachers should be available to keep the lesson on track, organize groupings, facilitate discussions, answer questions, and ensure that students meet all learning goals.

The following is a summary of the lesson screens:

Screen 1:   Students identify some common uses of fractions in their daily lives and routines, setting the stage for exploring fractions in the kitchen.

Screen 2:   Students review the basics of fractions. Then they watch a video of two students preparing to bake some cupcakes—only to learn that the students want to bake more than the recipe makes. The idea of "doubling" to maintain proportionality is introduced.

Screen 3:   Students learn what the goals are for the lesson, which strategies they will be using to complete the lesson, and the important vocabulary words they will use during the lesson.

Screen 4:   Students look at doubling from both additive and multiplicative perspectives. They read a recipe that they will return to throughout the lesson and write about their process of doubling a whole number.

Screen 5:   Students extend their knowledge of doubling to fractions, learning that 1/3 + 1/3 and 2 x 1/3 will both yield 2/3. They watch a short video of two cartoon characters exploring the process of doubling fractions.

Screen 6:   Students learn how to double nonunit fractions, such as 2/3, and watch a video that connects what they are learning about fractions to an actual baking problem. Converting an improper fraction to a mixed number is presented through an area model (though these terms are not introduced), and students write how they would double the fraction 2/7.

Screen 7:   Students continue to build their understanding of multiplying a whole number by a fraction. Area models are used in the discussion to move students toward a conceptual understanding of why 2 x 3/4, 3/4 + 3/4, and 1/4 + 1/4 + 1/4 +1/4 + 1/4 + 1/4 all result in 6/4. A formal method for multiplying a fraction by 2 is introduced. Students then complete a written critique of the math reasoning of a fictional student.

Screen 8:   Students learn a formal method for multiplying a fraction by any whole number: multiply the numerator by the whole number and leave the denominator as it is.

Screen 9:   Students read a story about two students who are baking three batches of oatmeal raisin cookies for a bake sale. They then explain how they can figure out how much milk they need if they want to give out ½ cup of milk to 100 people.

Screen 10:   Students answer three multiple-choice questions that assess their understanding of multiplying a fraction by a whole number.

Screen 11:   Students complete an interactive vocabulary activity, and then choose two words from the vocabulary list and write a new sentence for each word. These tasks demonstrate their understanding of the meanings of the words.

Screen 12:   Students use an interactive activity to identify equivalent representations of simple multiplicative and additive expressions, based on what they learned in the lesson.

Final
Assignment: Students select and complete a writing assignment about the lesson topic.

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Before the Lesson

❑ Go through each screen of the lesson, including all the interactive activities, so that you can experience ahead of time what students will be doing. As you go through each screen, jot down your own expectations for students' responses.

❑ Determine if students will be working individually or in pairs on the lesson. Some students may be able to work independently with little or no support. Students who are less familiar with the subject area or who struggle with literacy skills may benefit from working with another student. An effective way to do this is to pair a stronger student with a less able reader. You can also have students work individually on certain tasks and in pairs on others, depending on their experience and needs. If students will be working in pairs on any portion of the lesson, let them know if they will be expected to type in their notes individually or together.

❑ Provide instruction on key vocabulary (vocabulary words are defined in the lesson on screen 3, and on page 6 of this guide).

❑ Determine what students already know about fractions, multiplication, and using recipes. Record their ideas on a chart. You may want to structure the chart with these questions: "What is a fraction? When do you use or talk about fractions in your everyday life? (You may need to give an example to prompt thinking.) What is multiplication? How is it like addition?" This will give you a sense of the background knowledge and possible misconceptions that students have before beginning this lesson. If time allows, return to the chart after students have completed the lesson to add new learning and correct misconceptions. Note: You may want to record their new learning in a different-colored ink so they can see how much they've learned.

❑ Arrange computers with Internet access so students can work individually or in pairs.

❑ Before students begin, suggest a timeline for completing the lesson, mention the different types of media they will encounter, and let them know how you expect them to submit their work. You may want to provide an outline of this information on a chart, chalkboard, or whiteboard, or as a handout.

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Lesson Assessments

The following are descriptions of the lesson features that will be part of the packet of materials that students will submit. Students will use the packet for reference when writing their final assignment. It also serves as a formative assessment tool to monitor students' work as they are progressing through the lesson.

- **Notes** – Students take notes on screens 4, 6, 7, 8, and 9. If time allows, review their notes before students begin their writing assignment.

- **Multiple-choice questions** – Students complete the three questions on screen 10. Walk around to make sure students answer all three questions before they continue. If students click to go to the next page before they finish, their work will not be saved.

- **Match It!** – Students complete an interactive vocabulary activity on screen 11. They begin by dragging the vocabulary terms into the correct sentences. After they finish and save their work, they will be able to check their answers against an answer key. When they are done, they will be asked to choose two vocabulary words and write a new sentence for each word. Sentences should demonstrate a clear understanding of the meaning of each word. An inappropriate response would be "You can use an area model." An appropriate response would be "You can use an area model to show how to add fractions."

- **Arrange It!** – Students complete the concept map activity Arrange It! on screen 12. Students will arrange different expressions into matching groups, such that each group has an equivalent addition expression, multiplication expression, and fractional quantity. Students will not be able to check their answers online, so you will need to provide them with correct answers when they are finished with the lesson. You can choose to review the answers as a class or return the corrected packet of materials to students before they begin the final assignment.

  The proper distribution of answers is as follows:

  1/4 + 1/4 + 1/4
  1/4 x 3
  3/4

  3/5 + 3/5
  3/5 x 2
  6/5, or 1 1/5

  1/4 x 2
  1/4 + 1/4
  2/4

  1/5 + 1/5 + 1/5 + 1/5
  1/5 x 4
  4/5

- **Final Assignment** – Students complete one final writing assignment. You can choose to let students make their own selection or assign one according to your goals for the lesson. Use the rubric on page 7 to assess the writing assignments.

Lesson Aids and Extensions

Use the following suggestions to help students if they are stuck on a particular screen, to prepare students for completing their writing assignments, or as follow-up discussions to reinforce learning.

- **Watching Videos** – Encourage students to watch the videos more than once. After the initial viewing, provide students with a specific content focus to frame their next viewing(s) of the video. This will help them draw connections between the main topic and the information that the videos have to offer.

- **Participating in Discussions** – Organize class discussions or encourage students to talk about their questions in pairs. You may want to use the following discussion starters:

    o How are multiplication and addition related?

    o Why is it important to double every ingredient if you are doubling a recipe?

    o Based on what you know now, how would you double the number 2-1/3? How would you triple the number 9/10?

    o Why is it important to understand how to convert fractions?

    o Besides the kitchen, where else might you use fractions around the house?

- **Reading the PDF Text** – Before they read the PDF text on screen 9, ask students to review how addition and multiplication are similar and different, specifically with fractions. Then ask how they would double or triple a familiar fraction like 1/2. Invite students to share examples of when they have cooked a meal or baked a dessert with a family member and inquire whether they have ever had to work with fractions in the kitchen. After they read the PDF, ask students if they have any questions about how to multiply a fraction by a whole number or how to rename a fraction that has a larger numerator than denominator.

- **Sharing Student Work** – It may be motivational, and a further learning opportunity, for students to post their final essays so that their classmates, peers, and/or parents can see them. This may also provide an opportunity for students to comment on and discuss each other's essays.

    If you do not already have access to an online writing community, Teaching Matters™ provides TeXT, free classroom publishing tools that allow teachers and students to create and publish their own online eZine. More information and a free signup are available at Teaching Matters: TeXT (http://text.teachingmatters.org).

- **Reflection and Self-Assessment** – After students have turned in their writing assignments, you can choose to have them assess their learning. Bring students together as a whole class or in small groups to discuss the questions below. You may want to return to the chart of their ideas developed before the lesson and record their new learning. You may also have students respond individually to the questions and then convene the class to discuss the chart.

    o What did you learn?

    o What was surprising?

    o What questions do you still have?

    o What was the easiest for you to understand and do?

    o What was the most difficult?

Vocabulary Definitions

denominator

The bottom number in a fraction. The denominator indicates the number of equal parts that a whole has been divided into. The image below shows the fraction 2/5. The denominator of the fraction is 5.
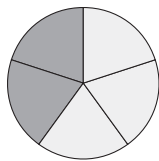

double

To make a number twice as large. You can double a number by multiplying it by 2 or by adding it to itself.

fraction

A number that expresses parts of a whole. When a fraction has a numerator of 1, it's called a unit fraction. Examples of unit fractions include 1/2, 1/3, 1/4, 1/25, and 1/33.

model

A picture of a mathematical idea. In an area model, the space inside a shape shows fractional parts.
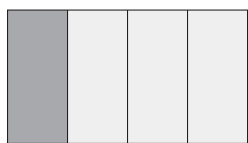
Area model showing 1/4

numerator

The top number in a fraction. The numerator tells you how many parts of a fraction you are identifying or counting. The image below shows the fraction 2/5. The numerator of the fraction is 2, which means that it is equal to 2 parts out of 5.
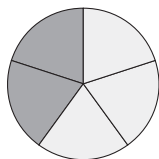
product

The result of two or more numbers that are multiplied together. The product of 4 times 3 is 12.

triple

To make a number three times as large. You can triple a number by multiplying it by 3 or by adding it to itself, and then adding it to itself again. For example, to triple the number 7, you could do this (7 x 3) or this (7 + 7 + 7).

Multiplying Fractions by Whole Numbers: Recipes

1. A student is struggling to understand how to triple the ingredients in a blueberry cake recipe. The recipe calls for 1/2 cup of butter, 3/4 cup of blueberries, and 2/3 cup of milk.

   a. Explain how to multiply a fraction by the number 3.

   b. Figure out how much of each ingredient she needs. (When you are writing your answer, you can write your fractions like this: 1/2, 1/4, or 6/2.)

2. A friend of yours says that he has a shortcut to increase the size of any recipe. "If I need to double the size of a recipe, I just add 2 to every ingredient," he says. "So if the recipe calls for 1/2 cup of sugar, I add 2 and use 2 1/2 cups of sugar."

Write a response to your friend, nicely telling him:

   a. Why this method will not work.

   b. Why adding the same amount to each ingredient is not the same as doubling.

   c. What he should do instead if he wants to double a recipe.

4	3	2	1
Provides a clear and accurate response to the question. Ideas are elaborated, with three or more relevant supporting details from the reading passage, video, and other materials in the lesson.	Provides an adequate response to the question. Topic and ideas are generally well organized, with two relevant supporting details from the reading passage, video, and other materials in the lesson.	Provides a generally accurate response, with one supporting detail from the reading passage, video, and other materials in the lesson.	Provides an inaccurate response to the question or fails to address the question. May include misinterpretations. Understanding of the topic is not apparent.
Uses at least three vocabulary words (or a form of the vocabulary words) from the lesson, and uses them all correctly.	Uses two vocabulary words (or a form of the vocabulary words) from the lesson, and uses them both correctly.	Uses one vocabulary word (or a form of the vocabulary word) from the lesson, and uses it correctly.	Does not use any vocabulary words, or uses vocabulary words incorrectly.

Final Assignment Rubric (page 2 of 2)
Multiplying Fractions by Whole Numbers: Recipes

3. In this lesson, you learned that multiplication and addition are related operations. Look at one of the two area models
below (refer to area models in the final assignment document.) Then do the following:

    a. Write both an addition problem and a related multiplication problem.

    b. Explain how adding fractions can help you multiply fractions.

4	**3**	**2**	**1**
Provides a clear and accurate response to the question. Ideas are elaborated, with three or more relevant supporting details from the reading passage, video, and other materials in the lesson.	Provides an adequate response to the question. Topic and ideas are generally well organized, with two relevant supporting details from the reading passage, video, and other materials in the lesson.	Provides a generally accurate response, with one supporting detail from the reading passage, video, and other materials in the lesson.	Provides an inaccurate response to the question or fails to address the question. May include misinterpretations. Understanding of the topic is not apparent.
Uses at least three vocabulary words (or a form of the vocabulary words) from the lesson, and uses them all correctly.	Uses two vocabulary words (or a form of the vocabulary words) from the lesson, and uses them both correctly.	Uses one vocabulary word (or a form of the vocabulary word) from the lesson, and uses it correctly.	Does not use any vocabulary words, or uses vocabulary words incorrectly.

Scoring the Rubric

Here are two suggestions for scoring the final assignment rubric. Select the option that best meets your needs or develop your own grading system.

Option 1: This option provides one score for each submitted assignment.

Assign a score of 4 or below for the written response (first row of the rubric) and a score of 4 or below for the use of vocabulary (second row of the rubric), for a total maximum score of 8. The interpretation of scores is as follows:

Score	Grade	Narrative Interpretation
7-8	A	Excellent
5-6	B	Good
4	C	Adequate (Fair)
3 or below	D	Minimal

Option 2: This option provides two scores for each submitted assignment: one for written content and one for the use of key vocabulary. An advantage of separate scores is that you can weight students' comprehension and composition differently than you do their knowledge of vocabulary. It can also help you identify specific needs for future instruction.

Assign a score of 4 or below for the written response (first row of the rubric) and a score of 4 or below for the use of vocabulary (second row of the rubric) and then score them separately. The interpretation of scores is as follows:

Score	Grade	Narrative Interpretation
4	A	Excellent
3	B	Good
2	C	Adequate (Fair)
1	D	Minimal

The final grade may look like this: A/B (A for content and B for vocabulary use).