Culminating Task - Adjusting a Recipe

STANDARDS FOR MATHEMATICAL CONTENT

Use equivalent fractions as a strategy to add and subtract fractions.
MCC5.NF.1 Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)*

MCC5.NF.2 Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.*

Apply and extend previous understandings of multiplication and division to multiply and divide fractions.
MCC5.NF.3 Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. *For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?*

MCC5.NF.4 Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.

a. Interpret the product $(a/b) \times q$ as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. *For example, use a visual fraction model to show (2/3) × 4 = 8/3, and create a story context for this equation. Do the same with (2/3) × (4/5) = 8/15. (In general, (a/b) × (c/d) = ac/bd.)*

b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.

MCC5.NF.6 Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

MCC5.NF.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.[1]

a. Interpret division of a unit fraction by a non-zero whole number, and compute such quotients. *For example, create a story context for (1/3) ÷ 4, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (1/3) ÷ 4 = 1/12 because (1/12) × 4 = 1/3.*

[1]Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But **division of a fraction by a fraction is not a requirement at this grade.**

b. Interpret division of a whole number by a unit fraction, and compute such quotients. *For example, create a story context for 4 ÷ (1/5), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that 4 ÷ (1/5) = 20 because 20 × (1/5) = 4.*

c. Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, how much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 1/3-cup servings are in 2 cups of raisins?*

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

ESSENTIAL QUESTIONS

- How can looking at patterns help us find equivalent fractions?
- How are equivalent fractions helpful when solving problems?
- How can a model help us make sense of a problem?
- How can making equivalent fractions, and using models, help us solve problems?
- When should we use models to solve problems with fractions?
- What connections can we make between the models and equations with fractions?
- How can we model an area with fractional pieces?
- How can modeling an area help us with multiplying fractions?
- What does it mean to decompose fractions or mixed numbers?
- How can decomposing fractions or mixed numbers help us multiply fractions?
- How can decomposing fractions or mixed numbers help us model fraction multiplication?

MATERIALS

- Adjusting a Recipe Task
- Pencil
- Accessible manipulatives

GROUPING
Pair/Small Group

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Comments:
This task was developed as a means to assess students' understanding of operations on fractions in a real world context. It is designed to allow students the freedom to approach the problem using a variety of strategies and allows for many different solutions depending upon class size.
Students should be allowed to draw representations of their thinking. This allows them to "talk through" their process which in turn enables students the opportunity to attend to precision as they explain and reason mathematically.

BACKGROUND KNOWLEDGE

Students engaging in this task should have had multiple experiences with fraction addition and subtraction, multiplication and division of fractions by whole numbers and whole numbers by fractions similar to problems in previous tasks.

Teacher Notes:

Introduce the problem and be sure everyone is clear with the context. You may wish to use the sample cookie recipe (included at the end of this task) or find another recipe that has several fractions in it to use.
Facilitate a preliminary discussion with the class to make sure students understand all vocabulary as well as the context of the problem, before students get to work. After allowing students to share their initial thoughts, ask them to work in pairs or individually to investigate the following:

How would you rewrite the recipe for twice as many people? Show your mathematical thinking and explain how you know the rewritten recipe is correct.

How would you rewrite the recipe for half as many people? Show your mathematical thinking and explain how you know the rewritten recipe is correct.

Is it possible to adjust the recipe to make 30 cookies? What would you have to do to the measurements of each of the ingredients?

Explain how you would adjust your recipe to feed everyone in our class (don't forget the teacher!) Is it possible to get the exact number of cookies for our class by adjusting the recipe? If not, adjust the recipe to get as close as possible (make sure everyone gets a cookie).

Possible struggles students may have can be turned into wonderful inquiries! As students investigate the screen areas, you may notice them:

Using array models or doubling ideas of multiplication to show how to double a recipe for some ingredients.

Using multiplication of fractions algorithm. This strategy may promote discussion, so please allow students the freedom to make sense of this in the closing part of the lesson.

Be on the lookout for students who, when working on halving the recipe, divide by ½ rather than by 2. This may be a lack of understanding of the concept of division. Scaffolding the students' learning with thought provoking questions can help students strengthen their conceptual understanding.

FORMATIVE ASSESSMENT QUESTIONS

- How can you tell that your answer is correct?
- Does dividing by 2 (or ½) help solve this problem? How do you know?
- Did you develop a strategy to find your answers?
- Did you identify any patterns or rules? Explain!

After enough time has been devoted to the task, ask students to make recipe cards to prepare for the closing of the lesson. Recipe cards should be clear enough for others in the class to understand their thinking, but should not just be the figuring that was initially done copied over again. The recipe cards should be clear and concise presentations of any important ideas and strategies students wish to present.

Some ideas to encourage discussion about in the presentations of student work:
Estimation, using whole number estimates can help determine whether measurements of ingredients are in the ballpark.
How fractions/mixed numbers are decomposed can make a difference.
Students who use any algorithm should also show understanding of the algorithm used with some kind of model.

Culminating Task - Adjusting a Recipe

Use the simple recipe for sugar cookies below or find another simple recipe in a recipe book or on the internet with at least four fractions in the ingredients list. Write the original recipe.

Rewrite the recipe for twice as many people. Show your mathematical thinking and show how you know the rewritten recipe is correct.

Rewrite the recipe for half as many people. Show your mathematical thinking and show how you know the rewritten recipe is correct.

Is it possible to adjust the recipe to make 30 cookies? What would you have to do to the measurements of each of the ingredients?

Explain how you would adjust your recipe to feed everyone in our class (don't forget the teacher!) Is it possible to get the exact number of cookies for our class by adjusting the recipe?

If not, adjust the recipe to get as close as possible (make sure everyone gets a cookie). How could we share the left-over cookie(s)?

How many batches of cookies would we need to bake if every student in the class receives the same number of cookies and no cookies were left over?

Simple Sugar Cookies (Makes 12)

Ingredients:

2/3 cup flour
1/4 teaspoon baking soda
1/8 teaspoon baking powder
1/4 cup butter, softened
3/4 cup white sugar
1 small egg
1/4 teaspoon vanilla extract

Directions:
Preheat oven to 375 degrees F (190 degrees C).
In a small bowl, stir together flour, baking soda, and baking powder. Set aside.
In a large bowl, cream together the butter and sugar until smooth. Beat in egg and vanilla.
Gradually blend in the dry ingredients. Roll rounded teaspoonfuls of dough into balls, and place onto ungreased cookie sheets. Bake 8 to 10 minutes in the preheated oven, or until golden.
Let stand on cookie sheet two minutes before removing to cool on wire racks.

Recipe adapted from http://allrecipes.com/recipe/easy-sugar-cookies/