Introduction to Common Denominators using the Fractionizer

Adding Fractions

Lesson time: 25-45 Minutes

Lesson Overview

Students will add fractions with unlike denominators by properly converting both fractions to the appropriate equivalent fraction with a common denominator. They will model this process visually before eventually doing the conversion and addition algebraically.

Lesson Objectives

Students will:

- Add fractions with like denominators both visually and algebraically
- Recognize that addition of positive fraction will always result in a larger fraction
- Recognize the problem of adding unlike denominators
- Model the conversion to an equivalent fraction with common denominator
- Determine the algebraic process for creating an equivalent fraction with a common denominator

Pre-requisites:

- Able to partition a rectangle or circle based on the denominator of a fraction.
- Able to shade the correct number of parts based on the numerator of a fraction.
- Be able to write a fraction given a rectangle or circle based representation.
- Have had some experience adding fractions of like denominators
  NOTE: If students cannot do the above, the Fractionizer may be a great tool to explore these activities, but this lesson will not outline those activities.

Anchor Standard

Common Core Math Standards

5.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.

Lesson Plan Summary

- **Introduction (5-10 minutes)**
- **Simulation and Activity (15-25 minutes)**
- **Reflection (5-10 minutes)**

Materials, Resources, and Prep

For the Student

- At least one computer (or tablet) for every two students
- One activity handout each
- Any handouts desired for the reflection activity

For the Teacher

- Ensure you can load the Fractionizer from your classroom: www.tinyurl.com/fractionizer
- Prepare the handouts for the activity: http://games.cs.washington.edu/fv/resources/AddingFractionsWorksheet.pdf
- Prepare at least one reflective activity for the class

Lesson Plan Details

Vocabulary

This lesson has a number of words that can be incorporated. These should not necessarily be introduced at the beginning but the teacher should try to use as many as appropriate and assess understanding of the chosen words upon completion:

- **Common Denominator:** A denominator which have two other denominators as factors. For instance 10 is a common denominator of 2 and 3 because 10 = 2 x 5 and 24 is a common denominator of 6 and 4 because 24 = 6 x 4. Note the 24 is not the LEAST common denominator because there is a smaller one for 6 and 4 which is 12 because 12 is 6 x 2 but also 4 x 3.
- **Equivalent Fraction:** A fraction is equivalent when the numbers are different but they represent the same quantity of parts to the whole. For instance, ½ of cake is equivalent to 2/4 of a cake. While not exactly the same, splitting a laser can be thought of as creating an equivalent fraction. Partitioning ½ into 3 parts create 3 lasers worth 1/6, so the analogy is that ½ is an equivalent fraction to (1/6 + 1/6 + 1/6) or 3/6.

Introduction

Students will come into this lesson with varying experience of fractions. In general, less talk at the start is better but activating some prior knowledge (especially student-to-student) may be helpful. Here are a few questions that might be worth discussing before (and definitely after) some game play. Note that you will also BRIEFLY be demonstrating the Fractionizer, so

include that into your estimate of how long you should be talking. The described demo below will cover most of these concepts.

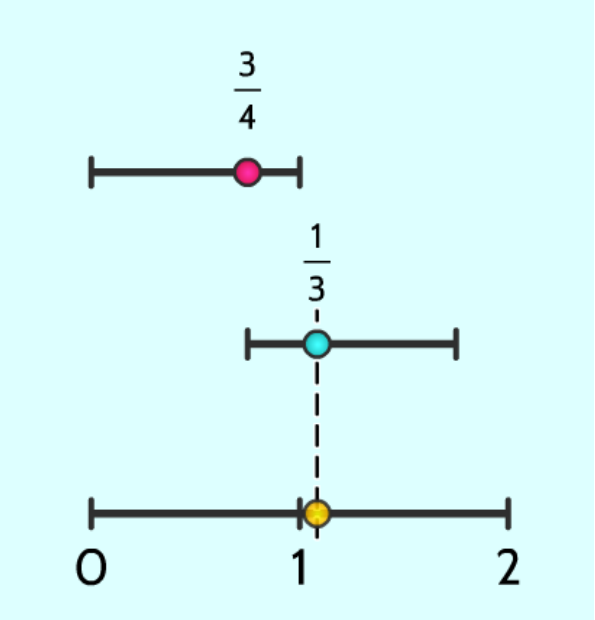
- If you had ¼ of a pizza and another ¾ of a pizza, how much pizza do you have altogether? [or other fractional addition prompts with SAME denominator]
- If you had ½ of a candy bar and ¾ of a candy bar, would you have more or less that a whole candy bar? [or other prompts with DIFFERENT denominators that sum to more or less than 1. The goal here is not to solve but to recognize that it is more than one AND that the exact number is a little tricky]
- What's the problem with add 1/3 and ½? Is it easier to show this with pictures or with numbers?

Activity: The Fractionizer: Fraction Visualization Simulator

The Fractionizer has lots of features and lots of representations which is usually a benefit. Let the students discover all of its features but feel free to say "That's very interesting. We're not looking at that right now. Can you remind us about it later."

TEACHER DEMO (10 Minutes)

1) The default fraction animation is ¾ + 1/3 using strip. DO NOT HIT PLAY YET.
2) Ask students "*Why this might be a problem?*"
3) **Switch the representation to number line and then hit play**. This will show the concept of ¾ + 1/3 is equal to SOME NUMBER more than 1. Watch this several times if needed. This is a good chance to show the controls at the bottom of the screen (#5 below). You may also want to change to some other fractions here using both the drop-down menus and the custom numbers (#1 and #2 below).
4) Switch the representation back to strip BUT use the **Custom Number** button to put **2/5** and **1/5** into the Number 1 and Number 2 box. DO NOT HIT PLAY YET.



5) Ask Students "*Do we know the answer to this one? Why is it easier that ¾ + 1/2 ?*"
6) Hit play. Explore pause/rewind/scrub as needed. Try some other combinations with LIKE DENOMINATORS. You might want to show a strip and a pie example. NOTE that if you add something where the results can be simplified (like ¾ and ¾) that the Fractionizer will simplify it.
7) See if one of the students can state the rule for adding fractions with like denominators. ("*Add the numerators, keep the denominator the same." Or "If you are adding 2 of something and 1 of something then you have 3 of something*")

8) Set the Fractionizer back to ¾ + 1/3 with a strip representation.
9) Ask the students if the number will be more or less than one. Ask "*Does anyone know what the denominator will be? Will it be 4ths/3rds/something else?*"
10) Hit Play. Watch this several times. See if any of the students would like to guess what is happening.
11) Ask the students "*Did dividing the 4ths into 3 parts each or the 3rds into 4 parts each change the overall size of either fraction?*", "*Why did the transformation to 12ths make the problem easier?*"
12) Make the point: "*2/3 and 12/18 are **equivalent fractions**. They represent the same size but 12/18 does it by having smaller parts but a lot more of them*"
13) Watch another using 5/6 and 2/3. Notice this gives a COMMON Denominator not a Least Common Denominator (you can teach that later once they understand the general principle of getting to a common denominator).
14) Now give out the worksheets. Rewind the example to the beginning and have each of the students shade 2/3 and 5/6.
15) Advance to the next step. Have the students add in the partition lines on 2/3. Remind them, to break into 6 parts we will make 5 cuts. Once they have turned their 2/3 into 12/18, have them write 2/3 x 6/6 = 15/18 across the top of that section.
16) Advance to the next step. Have the students add in the partition lines on 2/3. Remind them, to break into 6 parts we will make 5 cuts per section. Once they have turned their 2/3 into 12/18, have them write 2/3 x 6/6 = 15/18 across the top of that section.
17) Advance to the next step. Have the students add in the partition lines on 5/6. Remind them, to break into 3 parts we will make 2 cuts per section. Once they have turned their 5/6 into 15/18, have them write 5/6 x 3/3 = 15/18 across the bottom of that section.
18) Navigate to the middle of the next step that shows 12/18 in the middle. Pause it here. Have them break both the first and second whole into 18 parts each. Have them shade the first 12 parts.
19) Navigate to the end of this step that shows 12/18 and the 15/18 in the middle. Pause it here. Have them shade the next 15 parts.
20) Have them write 12/18 + 15/18 = 27/18 in the answer blank.
21) Now 27/18 simplifies to 3/2 and the Fractionizer shows this. It's recommended that you say "*Something a little unusual happens at the end of this animation. 27/18 has an equivalent fraction which is a bit simpler to write and it's 3/2 or 1 ½ . We aren't going to worry about that today. Some of our work will have these simplified fractions at the ends and others will not.*"

After 15-20 minutes, you should have students share their work and see if there are any common misconceptions around WHY you need a common denominator and HOW you create one both visually and algebraically. You might use this as a chance to mention there are some additional rules we have not learned but understanding these basic ideas are very important. You might also mention the rules for subtraction are very similar but the rules for multiplication and division will be quite different.

Reflection & Wrap-up

Research has shown **critical** that some form of debriefing takes place after any game in the class room for the learning benefits to be realized. Reflection is where the students transfer the play into learning outcomes. Based on your adaptation of this lesson, please choose **at least one** to implement in the classroom.

- The exit ticket provided in the handout document
- Have the students do a drawing of one of the fractions from class but using the pie or grid representation. Let them decide if they want to do it all in one "frame" or if they want to story board each section of the transformation. (This second option may take some time and would be an excellent extra credit homework assignment)
- Revisit the discussion questions. Have the students verbalize (and write if appropriate) the answers to two of these questions.
- Have the students try to do a handful of addition and subtraction problems. Let them use the Fractionizer for support if they need it. For ideas, see: http://www.commoncoresheets.com/Math/Fractions/Adding-Sub%20Fractions%20%28Different%20Denom%29/English/1.pdf
- Challenge: Word Problems: http://www.commoncoresheets.com/Math/Fractions/Word%20Problems%20Different%20Denom/English/1.pdf

END OF LESSON PLAN. MATERIAL BELOW THIS POINT FOR REFERENCE ONLY. NO NEED TO PRINT (OR READ UNLESS CURIOUS).

FRACTIONIZER NOTES:

You should make your students aware of a few features (if you follow the demo, then these will all be shown):

1) Most every day fractions can be found by clicking on the Number 1 and Number 2 drop downs.
2) If you want an unusual fraction, click on the Custom Numbers switch and type the number into the Number 1 or Number 2 box
3) Click on Play to make the animation go
4) Changing Representations gives you a different shape AND may present the animation slightly differently
5) When the animation is running you can pause/unpause by tapping in the middle and you can fast-forward and back up using the controls at the bottom of the screen.

More details about the specific workings of the Fractionizer can be found here:
http://games.cs.washington.edu/fv/resources/FractionizerOperationRepresentationGrid.pdf