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| **Synopsis of high-quality task:**  Students will gather data to convert fractions with unlike denominators and compare them to determine success rate for flipping water bottles.  **Anticipated student time spent on task:** Two 45-minute periods  **Student task structure(s):**  Small group work for data collection and whole group lesson. Independent work for final data conversion. |
| [**Math Content Standards and Practices**](http://www.doe.mass.edu/frameworks/math/2017-06.pdf)**:**  **4.NF.A.1** Explain why a fraction *a*/*b* is equivalent to a fraction (*n* × *a*)/(*n* × *b*) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions greater than 1.  **4.NF.A.2** Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.  **4.NF.B.3.d** Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using drawings or visual fraction models and equations to represent the problem.  **SMP 1** Make sense of problems and persevere in solving them  **SMP 4** Model with mathematics  **SMP 5** Use appropriate tools strategically  **SMP 6** Attend to precision |
| **Prior Knowledge:**  **3.NF.A.1**Understand a fraction 1/*b* as the quantity formed by 1 part when a whole (a single unit) is partitioned into *b* equal parts; understand a fraction *a*/*b* as the quantity formed by *a* parts of size 1/*b*.  **3.NF.A.3.b** Recognize and generate simple equivalent fractions, e.g., 1/2 = 2/4, 4/6 = 2/3. Explain why the fractions are equivalent, e.g., by using a visual fraction model.  **3.NF.A.3.d** Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. |
| **Connections to the real-world:**  Students will be participating in a popular international trend of flipping water bottles to spark interest in gathering data and converting fractions with unlike denominators. |
| **Mastery Goals:**  **Learning Objective:**  Students will be able to convert fractions with unlike denominators for comparison.  **Language Objective:**  Students will explain which fraction is greater than or less than using the vocabulary. |
| **Instructional Tips/Strategies/Suggestions:**  **Prior Preparation:**  You will need to collect empty water bottles. Enough for each group to have 4. They should be empty when you give them to the students.  Have 2 full water bottles available for groups to add various amounts of water to each water bottle.  Copy “CLASS DATA” chart onto 2 separate pieces of chart paper for students to record whole-class data.  **Teacher Instructions:**   1. Recall fractions prior knowledge with students - Factors, Least Common Denominator (LCD), calculating a fraction, simplifying fractions, numerator, denominator 2. Arrange students into groups of 4 3. Give each group the 4 empty water bottles, 2 full water bottles, measuring cup, a permanent marker, and a copy of the Activity 1 worksheet for each student. 4. Assign each group a number (i.e. group 1, group 2, etc). 5. Using the permanent marker, have students label each bottle A, B, C, or D 6. Using the chart in the “directions” section of the Activity 1 worksheet, have students calculate the fraction of water they are putting in each water bottle and have them simplify each fraction as well. 7. Using the measuring cups, have students pour the correct amount of water into each bottle.      1. Assign each group an amount of flips they will be doing (i.e. 5, 10, 20, 25). Have each person in each group circle that number on their worksheet. 2. Review directions under “Group Data.” Explain they should be using tally marks to record   successful flipping attempts. Some groups will be finished in a much shorter amount of time due to the number of flips their group is assigned. For more data, and so that groups will be finished at about the same time, you can provide students with two copies of the “Group Data” page and provide them with two trials to complete (suggestions: 5 and 25; 10 and 20). Depending on the amount of class time, these trials could be completed separately (i.e. do 5 flips, *then* do 25 flips) or concurrently (i.e. the first 5 flips are recorded, which are *part of* the 25 flips)   1. Students may begin flipping their bottles and recording the data. 2. While students are flipping their bottles move around to each group and talk to them about the data they have collected so far. Check for correct data collection (i.e. tallies) and ensure on-task behavior. 3. After you have met with each group and all the groups have finished flipping their bottles,   review how to turn the data (tallies) into a fraction for landed and missed bottles and  have them record the fractions on their “Group Data” sheet.   1. Have students verify they have the right data by adding the 2 fractions for successful and unsuccessful attempts for each bottle (i.e. ⅖ + ⅗ = 5/5, fraction for successful attempts + fraction for unsuccessful attempts = fraction equivalent to one whole). 2. Have students answer the questions regarding which bottle was most successful (A, B, C, or D) and which one was least successful. 3. When groups finish their data-collecting, they should write the data for their group on the CLASS DATA chart paper. You will use this data to teach comparing fractions by converting denominators. 4. Ask each group to share which one of their bottles was most successful and which was least successful. 5. Brainstorm why students think one bottle was more successful than another. 6. As a whole-group lesson, explain that they will be learning how to compare fractions with different denominators by finding the Least Common Denominator (LCD). 7. Explain that students will need to find the common multiples in order to identify the LCD. You may want to do a few examples before using the Class Data collected. 8. Using the “Class Data,” continue working together to identify the LCD and how to convert the fractions by multiplying the numerator and denominator to create the common denominator. Once all of the fractions are converted for a particular bottle, students will be able to easily identify the most successful group for each bottle. Complete this section as a class, allowing students to work together and ask questions. 9. Once you have completed the whole-class section, students will move on to Activity 2 which involves adding different items to the water bottles they are currently using (popcorn kernels, white beans, rice, marbles). 10. Give each group the items to add to their bottles as well as the Activity 2 worksheet. Students will now complete the flipping and collecting of data again. 11. Again, a student from each group will record their data on the “Class Data” chart paper for Activity 2. 12. Once all the flipping is completed and the data is presented, each student should work   independently on comparing the fractions by converting to LCD.   1. Once completed, students should pass in their Activity 2 worksheet for assessment. |
| **Instructional Materials/Resources/Tools:**  **Materials:**   * Enough empty 16 oz. water bottles for each pair/group to have 4 * 2 full water bottles for each pair or group * Enough 2-cup measuring cups for each pair/group to have 1 * Chart paper * Permanent markers for labeling bottles & chart paper * Popcorn kernels, white beans, marbles, rice * Small cups - used for items above * Student Activity Sheet 1 - completed together - attached * Student Activity Sheet 2 - completed independently for assessment - attached |
| **Accessibility and Supports:**  Students can be provided with multiplication charts as needed. In addition, students can be provided with a checklist of steps for finding equivalent fractions.  **Potential sentence starters:**  My first step is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  The numerator is \_\_\_\_\_\_\_\_\_\_\_\_\_.  The denominator is \_\_\_\_\_\_\_\_\_\_\_.  There are \_\_\_\_\_\_\_\_\_\_ parts in the whole.  **Key academic vocabulary:**  factors, least common denominator (LCD), simplifying fractions, numerator, denominator |

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ #\_\_\_\_\_

**Activity 1**

Does the amount of water in a water bottle effect the fraction of bottle flips that will land upright?

**Directions:**

* Using 4 empty water bottles and label them A, B, C, & D.
* Using the measuring cup provided add the following amounts of water in each bottle 12oz, 8oz, 4oz, 2oz.
* Calculate what fraction of the water bottle is filled and write the fraction in the chart below.

|  |  |  |
| --- | --- | --- |
|  | Amount of water in  ounces | What fraction of the bottle is filled with water? |
| Bottle A | 12oz |  |
| Bottle B | 8oz |  |
| Bottle C | 4oz |  |
| Bottle D | 2oz |  |

**Group Data**

**Directions:**

1. Taking turns, flip each bottle **5 10 20 25** times and have another person in your group use tally marks to record how many successful and unsuccessful flips for each bottle in the chart below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bottle | A | B | C | D |
| Landed |  |  |  |  |
| Missed |  |  |  |  |
| Fraction of Landed Bottles |  |  |  |  |
| Fraction of  Missed  Bottles |  |  |  |  |

**Results**

Using your data from the chart above compare the fraction of successful and unsuccessful attempts for each bottle.

Which bottle was most successful? Bottle\_\_\_\_\_\_\_\_ with \_\_\_\_\_\_oz.

Which bottle was least successful? Bottle\_\_\_\_\_\_\_\_ with \_\_\_\_\_\_oz.

One student from your group should record your data on the chart paper provided at the front of the room.

**Class Data**

Record the class data from the chart paper into the chart below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Bottle A** | **Bottle B** | **Bottle C** | **Bottle D** |
| **Fraction of**  **Landed Bottles**  Group 1 -  Group 2 -  Group 3 -  Group 4 - | **Fraction of**  **Landed Bottles**  Group 1 -  Group 2 -  Group 3 -  Group 4 - | **Fraction of**  **Landed Bottles**  Group 1 -  Group 2 -  Group 3 -  Group 4 - | **Fraction of**  **Landed Bottles**  Group 1 -  Group 2 -  Group 3 -  Group 4 - |

**Using the data in the chart above create a common denominator to compare the fractions of landed bottles for each group**

SHOW YOUR WORK!

Which group was most successful for Bottle A?\_\_\_\_\_\_\_\_

Which group was most successful for Bottle B? \_\_\_\_\_\_\_

Which group was most successful for Bottle C? \_\_\_\_\_\_\_

Which group was most successful for Bottle D? \_\_\_\_\_\_\_

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ #\_\_\_\_\_

**Activity 2**

Will adding items to a water bottle affect the fraction of bottle flips that will land upright?

**Directions:**

* Using the water bottles from Activity 1 and the chart below add a different item to each water bottle.

|  |  |
| --- | --- |
|  | Item |
| Bottle A | rice |
| Bottle B | marbles |
| Bottle C | popcorn kernels |
| Bottle D | white beans |

**Group Data**

**Directions:**

1. Taking turns, flip each bottle the **same amount of times** you did in Activity 1. Have another person in your group use tally marks to record how many successful and unsuccessful flips for each bottle in the chart on the next page.

**Group Data**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Bottle | A | B | C | D |
| Landed |  |  |  |  |
| Missed |  |  |  |  |
| Fraction of Landed Bottles |  |  |  |  |
| Fraction of  Missed  Bottles |  |  |  |  |

**Results**

Using your data from the chart above compare the fraction of successful and unsuccessful attempts for each bottle.

Which bottle was most successful? Bottle\_\_\_\_\_\_\_\_ with \_\_\_\_\_\_oz.

Which bottle was least successful? Bottle\_\_\_\_\_\_\_\_ with \_\_\_\_\_\_oz.

One student from your group should record your data on the chart paper provided at the front of the room.

**Class Data**

Record the class data from the chart paper into the chart below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Bottle A** | **Bottle B** | **Bottle C** | **Bottle D** |
| **Fraction of**  **Landed Bottles**  Group 1 -  Group 2 -  Group 3 -  Group 4 - | **Fraction of**  **Landed Bottles**  Group 1 -  Group 2 -  Group 3 -  Group 4 - | **Fraction of**  **Landed Bottles**  Group 1 -  Group 2 -  Group 3 -  Group 4 - | **Fraction of**  **Landed Bottles**  Group 1 -  Group 2 -  Group 3 -  Group 4 - |

**Using the data in the chart above create a common denominator to compare the fractions of landed bottles for each group**

SHOW YOUR WORK!

Which group was most successful for Bottle A?\_\_\_\_\_\_\_\_

Which group was most successful for Bottle B? \_\_\_\_\_\_\_

Which group was most successful for Bottle C? \_\_\_\_\_\_\_

Which group was most successful for Bottle D? \_\_\_\_\_\_\_

|  |
| --- |
| **Sample Student Work:**  **Student work, activity A. Bottle A: 12/6 to 3/4. Bottle B 8/16 to 1/2. Bottle C 4/16 to 1/4. Bottle D 2/16 to 1/8.Student work, group data. Tallies of landed bottle A: 5, bottle B 6, bottle C 5, Bottle D 7. Tallies of Missed bottle A 20, bottle b 19, bottle B 20, bottle D 18. Fraction of landed bottle A 5/25 = 1/5. Bottle B 6/25. Bottle C 5/25 = 1/5. Bottle D 7/25. Fraction of missed bottle A 20/25. Bottle B 19/25. Bottle C 20/25. Bottle D 18/25.  Results: Bottle D was most successful with 2 ounces. Bottles C and A were least successful with 4 and 12  ounces.Student work, class data. Bottle A fraction of Landed bottles: Group 1, 1/20. Group 2, 0/10. Group 3, 0/5. Group 4. 5/25. Bottle B fraction of landed bottles: Group 1, 3/20. Group 2, 0/10. Groups 3, 0/5. Group 4, 6/25. Bottle C fraction of landed bottles: group 1, 5/20. group 2, 2/10. group 3, 2/5. group 4, 5/25.  Bottle D Fraction of landed bottles: group 1, 7/20. group 2, 1/10. group 3, 2/5. group 4, 7/25.  Group A was most successful for bottle A. The student showed work of converting to common denominators.Student work. group 4 was most successful for bottle B. Group 3 most successful for bottle C. Groups 3 most successful for Bottle D. The student showed work of converting to common denominators.Student work, activity 2. no student work on the first page.Student work. tallies of landed bottle A: 5. Bottle b: 6. Bottle C: 2. bottle D: 6. tallies of missed bottle A: 20. Bottle B: 14. Bottle C: 23. Bottle D: 14. Fraction of landed bottle A: 5/25. Bottle B: 6/25. Bottle C: 2/25. Bottle D: 14/25.  Fraction of missed bottle A: 20/25. Bottle B: 14/25. Bottle C: 23/25. Bottle D: 14/25.   Bottle B with 8 ounces was most successful. Bottle C with 4 ounces was least successful.Student Work, Activity 2 class data. Fraction of landed bottle A: Group 1, 2/20. Group 2, 1/10. Group 3, 0/5. Group 4, 5/25. Fraction of landed bottle B: Group 1, 3/20. Group 2, 1/10. Group 3, 0/5. Group 4, 6/25. Fraction of landed bottle C: Group 1, 4/20. Group 2, 2/10. Group 3, 2/5. Group 4, 2/20. Fraction of Landed bottle D: group 1, 4/20. group 2, 2/15. group 3, 2/5. group 4, 6/25.  group 4 was most successful for bottle A. The student showed work of converting to common denominators.Student work, activity 2. group 4 was most successful for bottle b; group 3 for bottle c; and group 3 for bottle d. The student showed work of converting to common denominators.** |