5th grade public research lesson on May 21, 2005
at the National Teachers Academy Professional Development School

Mathematics Lesson Plan for Fifth Grade

For the lesson on May 21, 2005
At NTA-PDS, Lorna Holliday's class
Instructor: Lorna Holliday
Lesson plan developed by: Donna Thigpen, Kathleen Finke, Heather Brown, Jen Kowieski

1. Title of the Lesson: Punch Mix-up
2. Goal of the Lesson:
   - To be able to create a method to solve proportional relationship equations and adapt that method, as necessary, to multiple real-life situations.
   - To develop the ability to consider relations between two quantities that vary with each other.
     1. To understand the meaning of direct proportion. To investigate its features
        by using mathematical expressions and graphs in simple cases.
     2. To recognize real-life cases which may be efficiently treated by paying attention to proportional relation.
3. Relationship of the Lesson in the Illinois Learning Standards for Mathematics.

Related prior learning standards (topics/objectives).

1. Fractional relationship (part to whole)
2. Equivalent fractions
3. Multiplying fractions
4. Least Common Multiple
5. Ratio
6. Line Graphs

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This Lesson

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State Goal 6: Demonstrate and apply a knowledge and sense of numbers, including numeration and operations (addition, subtraction, multiplication, division), patterns, ratios and proportions.

A. Demonstrate knowledge of use of numbers and their representations in a broad range of theoretical and practical settings.
B. Solve problems using comparison of quantities, ratios, and proportions and percents.

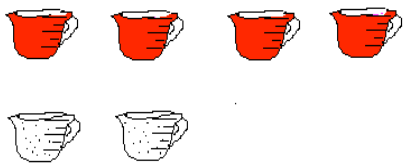
State Goal 8: Use algebraic and analytical methods to identify and describe patterns and relationships in data, solve problems and predict results.

A. Describe numerical relationships using variables and patterns.
B. Interpret and describe numerical relationships using tables, graphs and symbols.
D. Use algebraic concepts and procedures to represent and solve problems.

4. Instruction of the Lesson

(a) My students need to understand and learn the relationship between equivalent fractions and proportionality.
(b) My students have learned of two methods to find equivalent fractions, how to find least common multiples and how to create line graphs from given data.
(c) The focus of this lesson is the relationship between, equivalent fractions, ratio and proportionality.
(d) That a clear understanding of equivalent fractions can be used to introduce ratio and proportion.

5. Learning Process (or Plan of Lesson)

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher's Support	Points of Evaluation
1. Introduction Pose the question: If you made a punch mixture that is 4 cups of cranberry juice and 2 cups of sparkling water. How many cups of punch mixture would this make?  Anticipated solutions: Students may not understand that <u>all</u> the cups total to equal 6 cups of punch. Responses: 4 cups of punch 6 cups of punch 8 cups of punch 12 cups of punch How much juice you will need if you double the recipe? 6 cups of water? 1 cup of water? Anticipated responses: Incorrect responses 4 cups water + 6 cups juice 6 cups water + 8 cups juice 1 cup water + 3 cups juice Correct responses 4 cups water + 8 cups juice 6 cups water + 12 cups juice 1 cup water + 2 cups juice	**Class discussion:** Teacher displays 3 cups of juice and 5 cups of water. Ask for student responses. Do students know that each cup juice and water total the amount of punch you can make. During class discussion note if students understand question and can give correct proportions. Encourage students to understand that proportionality is closely related to multiplication. Student should look for patterns to make predictions.	Do students understand the part-to-whole ratios of juice and water to the total amount of punch? Do students multiply to increase the recipe? Do students know how to divide the number of cups of juice by the number of cups of water to find the ***n-to1 ratio***? Do students understand that ***n-to-1 ratios*** are useful when comparing ratios?

Create a chart for correct amount of juice, water and total amount of punch after students give responses.
Anticipated Response:

Juice	Water	Punch
4	2	6
8	4	12
12	6	18
2	1	3
x # parts water	#Parts of water	3 x # parts water

Encourage students to find the relationships of:

- Part to part ratios of juice to water
- Part to whole ratios of juice and water to the total amount of punch

Do students express the proportional relation algebraically by observing the pattern in the table?

#parts juice equals 2 times # parts water.

#parts punch equals 3 times# parts of water.

#parts water equals #parts juice divided by 2

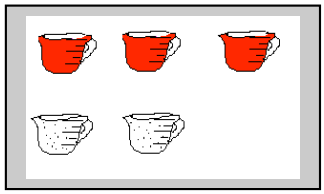
2. Posing Problem 1

You are making a punch mixture for the Chicago Public Lesson Study. Mrs. Holliday has three recipes. You need to decide which recipe will make the strongest cranberry punch mixture? Or which recipe has the most cranberry juice? Here are three recipes that call for different quantities of cranberry juice and water.

Recipes	A	B	C
Cranberry juice	3	6	3
Sparkling Water	2	5	5

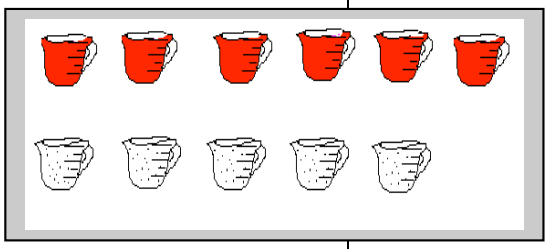
Which recipe has the weakest amount of cranberry juice?
Why?

Recipe A

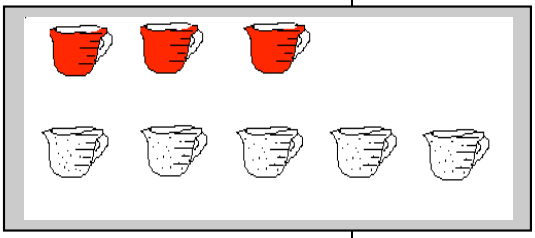


Display pictures of cups of juice and water for each recipe.

Recipe B



Recipe C



Anticipated Students' Solutions

Different correct methods:

- First determine which recipe is the weakest, looking at the amount of juice to water. The 3 cups juice and 5 cups water is obviously less cranberry juice.
- Students could also look at how much juice is proportional to the total amount of punch. And see that the 3 cups of juice is less than the 5 cups of water in the total amount of punch.

Case by case support based on need of individual groups.

Redirect student understanding of ratio.

Are students on track?
Do students understand, and can he/she express that understanding?

How deeply entrenched is the student's misunderstand-ing of the concept?

Posing Problem 2

Teacher directs students attention to two pitchers of punch A and punch B.

You will now need to decide which recipe will make the strongest cranberry punch mixture? Or which recipe has the most cranberry juice? Here is recipe A and B.

Recipes	A	B
Cranberry juice	3	6
Sparkling Water	2	5

Who would like to taste the two punches to decide which has more cranberry juice?

Before you taste the punch, use what you have learned today to decide which punch has more cranberry juice.

Discuss with your group your reasoning and write your response in your journal. Show all

Use what you learned in the previous examples to compare recipe A and B to find which has more cranberry juice.
Discuss with your group your reasoning and write your response in your journal. Show all your work

because it has more cups of cranberry juice. Redirect their thinking to an n-to-1 ratio to find which recipe has the most juice.

students use the solutions from the previous problems to compare ratios of juice to water and ratio of juice to total punch.

4. **Comparing and Discussing**

Students will discuss their choice of the strongest recipe. How they were able to determine which recipe was the stronger. Encourage students to compare the amounts of juice and water in each recipe and the amount of juice and water to the total amount of punch.

<table>
<tr>
<td>
Possible methods:
1. Recipe A because B has too much water.
2. They are the same because they both have less water.
3. Recipe B because it has more cups of juice.
4. Recipe A because recipe B has 2 times the amount of juice, but 2.5 times the amount of water.
5. Students will use previous methods for comparing how the amounts of juice and water are proportional to each other and to the total amount of punch.
Recipe A
<table>
<tr><td>Juice</td><td>Water</td><td>Punch</td></tr>
<tr><td>1.5</td><td>1</td><td>2.5</td></tr>
<tr><td>3</td><td>2</td><td>5</td></tr>
<tr><td>4.5</td><td>3</td><td>7.5</td></tr>
<tr><td>6</td><td>4</td><td>10</td></tr>
<tr><td>7.5</td><td>5</td><td>12.5</td></tr>
<tr><td>9</td><td>6</td><td>15</td></tr>
<tr><td>1.5 x #parts water</td><td>#Parts of water</td><td>2.5 x # parts water</td></tr>
</table>
Recipe B
<table>
<tr><td>Juice</td><td>Water</td><td>Punch</td></tr>
<tr><td>1.2</td><td>1</td><td>2.2</td></tr>
<tr><td>2.4</td><td>2</td><td>4.4</td></tr>
<tr><td>3.6</td><td>3</td><td>6.6</td></tr>
<tr><td>4.8</td><td>4</td><td>8.8</td></tr>
<tr><td>6</td><td>5</td><td>11</td></tr>
<tr><td>7.2</td><td>6</td><td>13.2</td></tr>
<tr><td>1.2 x #parts water</td><td>#Parts of water</td><td>2.2 x # parts of water</td></tr>
</table>
</td>
<td>
Students will build on their skills working with ratios.

Students will need to find how much juice is needed for 1 cup of water (n-to-1 rato).

Students will need to find the ratio comparison of juice to water (n-to-1 ratio).

Student should use a chart to discover which recipe has the most juice:
Recipe A the ratio is 6 cups of water to 9 cups of juice.
Recipe B the ratio is 6 cups of water to 7.2 cups of juice.

<u>Recipe A</u> <u>has more juice.</u>
Students could continue the chart to find the recipe with the most water:
Recipe A the ratio is 6 cups of juice to 4 cups of water.
Recipe B the ratio is 6 cups of juice to 5 cups of water.

<u>Recipe B</u> <u>has more water.</u>
Students will taste and examine cranberry juice dilutions to test if their proportional reasoning is accurate.
</td>
<td>
Do students divide to find the ratio comparison (n-to1 ratio) of juice to water?

Do students use table from previous example to compare recipes?

Do students compare recipe A to recipe B?
Recipe B has two times the amount of juice.
Recipe B has 2.5 times the amount of water.
</td>
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<tr>
<td>5. Summing up
Students will write a journal entry, “What did I learn today about proportions and making comparisons.”</td>
<td>Review and clarify for students the accuracy of procedural thinking.</td>
<td>Students demonstrate an ability to explain their thinking in a logical cohesive way.</td>
</tr>
</table>

6. Evaluation
   - Were students able to articulate their understanding of ratio?
   - Are students able to formulate a plan to use ratio to clarify proportion?