Comparing Liquid Volume Units with Fractions and Decimals

Lesson Summary Students will use 2-dimensional models, fractions, and decimals to compare 3-dimenetional values.

Major Topic and SOL

Math SOL (2009) 4.2.a, 4.2.b, 4.2.c, 4.12.b

Length of Unit 2 – 50 minute periods

Student Objectives

In Mathematics the student will be able to:

- Exchange equivalent measurements between units within the U.S. Customary system using ounces, cups, pints, quarts, and gallons.
- Approximate conversions between liters and quarts, and between milliliters and liquid ounces and/or cups.
- Describe the relationships between units of measurements using fractions and decimals.

In Language the students will be able to:

- Express reasonable estimates of realistic measurements using appropriate units.
- Use vocabulary to express the same amount in U.S. Customary and metric units.
- Name the values as both fractions and decimals.

21st Century Skills

- Critical-Thinking and Problem Solving
- Communication
- Creativity and Innovation
- Collaboration
- Information and Media Literacy
- Contextual Learning

Assessment Evidence

- As students complete the attached worksheet it should be collected and evaluated for understanding and accuracy of at least 90%.

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Supplies/Materials/Technology

- **Teacher Materials:**
  - An assortment of measuring cups, graduated cylinders, beakers, jugs, bottles, and other containers in both customary and metric sizes; the greater the variety in sizes and shapes (even of the same sizes) the better.
  - Supply of water
  - Food coloring to tint the water
- **Student Materials:**
  - 1 set per student of 5 colored paper sheets 8 ½ x 11 (I used green, orange, pink, blue, and yellow.) and ½ of a sheet of white legal-sized paper cut hotdog style and then trimmed to 4 ¼ x 11 ½.
  - Student scissors
  - Pencils and colored pencils
  - Scratch paper
  - 1 Plastic bag (gallon size)

Lesson Plan

Motivation & Building Background:

- **Background:** The students should have previously studied the use of fractions and decimals as numbers, including identifying both from diagrams and concrete objects, finding equivalent fractions and decimals, and adding and subtracting both fractions and decimals. They should have also used fractions and decimals to describe measurements of distance and weight in both U. S. Customary and metric units.
- **Motivation:**
  - Display a variety of measuring devices and ask the students to name some ways they might use those devices in their daily lives. Ask them to describe any previous experiences they may have encountered with similar tools. Ask them to name anything they might be able to purchase in any of the containers.
  - Ask students to compare and contrast two-dimensional and three-dimensional figures.
  - Read and discuss the lesson objectives with the students.

Presentation

- Hold up a sheet of green paper and a gallon jug and tell the students that they will be exploring 3-dimensional concepts in two dimensions by using the flat sheets of paper to represent amounts of liquid. Explain that the 8 ½ x 11 sheet of paper represents the gallon jug, and each is the base unit of 1 whole. Ask the class to name different ways they can write one (1, 1/1, 1.0, etc.). Pass out the packets of paper and tell students to

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find their green sheet and label it as one gallon. Ask students to name things that they might measure using gallons. Make a list of their ideas on the board under the heading of **Gallon**.

- Hold up the orange sheet while asking the class to find their papers and follow along as you fold the paper in half "hamburger" style. Tell them to cut the paper into two equal parts. Ask them to name the two parts; they should identify each part as one-half gallon. Tell them to label the two half sheets. Ask them to list anything they can think of that might be found in half-gallon containers (such as milk or juice in a store). Write their ideas on the board under the heading **Half-Gallon**. Ask the students to name different ways to write one-half (1/2, .5, etc.).

- Holding up a pink sheet, follow a similar process having the students fold their sheets in half once and then in half again, so that when unfolded they will see four equal parts. Ask them to name their parts while they cut them apart and label the parts. Some may name the parts as fractions, or fourths, first before thinking in terms of volume units, or quarts. When they have identified both names ask them to make a statement as to the relationship between quarts and a gallon, *four quarts equals one gallon* or *one gallon equals four quarts*. Ask them to identify items that are commonly found in quart containers and list them under the heading **Quart**. Have them give different ways of writing one-fourth (1/4, .25, etc.).

- Show the group a blue sheet, having them fold in half once, twice, then a third time. Unfolding the sheet should reveal eight equal sections; have the students begin cutting and labeling their sheets while trying to identify the names of the parts. Some students may identify the parts as eighths before being able to identify them as **pints**. After identifying the pints, ask the class to make statements about the relationship between pints and gallons such as *one gallon equals eight pints* or *eight pints equals one gallon*. Then ask them to list items commonly found in pints and name different ways to write one-eighth (1/8, .125). Before moving to the next color and unit, have the students compare the pint sections with the quart sections. The goal is to have them relate that two pints is the same as one quart and then make statements such as *one quart equals two pints* or *two pints equals one quart*.

- Holding up the yellow sheet, lead the class in folding once, twice, three times, and finally a fourth time, so that when unfolded they reveal a sheet divided into sixteen equal parts. Help them identify the parts as sixteenths and as **cups**. They should brainstorm for things measured in cups and ways to write one-sixteenth as they cut and label the parts. Have them make statements about the relationship between cups and gallon (*sixteen cups equals one gallon*), and then cups and pints (*two cups equals one pint*), and cups and quarts (*four cups equals one quart*).

- Have the students fold one of the cup sections three times (as done for the pint sheet) to show eight equal parts on that cup piece. (Drawing lines with a colored pencil to create the sections can be substituted for folds.) Identify these eight parts as **ounces**. Elicit statements that *eight ounces equals one cup*. Ask students what things might be measured in ounces.

- Ask the group to hold the white sheet up to the gallon sheet, indicating that the white sheet is slightly longer than the gallon sheet. If the gallon sheet is folded in half they will see that the white sheet is a little more than half of the gallon. Tell them that this is similar to a two-liter bottle. Have them fold and cut the white sheet into two halves, identify them as **liters**, and then find what other part they have made is closest to the liter. They should identify the quart as being closest to the liter. Elicit statements about a relationship between liters and quarts and liters and gallons in order to establish that since *one liter is a little more than one quart*, then *four liters is a little more than one gallon*. Lines can be drawn to show how a liter can be subdivided into tenths (deciliters), then one deciliter divided into centiliters, and finally one centiliter into milliliters to demonstrate the tiny units.

Practice/Application

- Ask the students to consider the units of measure they have created in order to now write sentences using fractions to compare the units. On the board give the example **1qt = ¼ gal**. Allow students to volunteer similar statements as examples, then have them work in pairs to create as many such statements as they can in about five minutes. Check that groups are correctly identifying equivalent measurements. After a reasonable time, stop the group and give the following examples on the board: **4 c = ____ gal** and **4 Oz = ____ c**. Ask students to help complete the statements as ***4 c = 1/4 gal*** and ***4 Oz = 1/2 c***. Permit pairs to continue working for ten more minutes to create more comparison statements. Individuals will then complete the attached worksheet.

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Name: ____________________ Measurement Date: __________

Tell the full name for each abbreviation.

1. gal _______________ 2. qt _______________ 3. pt
____
4. c _______________ 5. oz _______________ 6. tsp
____
7. T _______________ 8. lb _______________ 9. L
____
10. ml _______________ 11. kl _______________ 12. g
____

Fill in the blank with the correct answer. Some answers may need whole numbers, mixed numbers,
fractions, decimals, or unit names.

13. 1 gal = ______ qt 14. 1 qt = ______ pt 15. 1 pt = ______ c 16.
1 c = ______ oz
17. 3 gal = ______ qt 18. 5 qt = ______ pt 19. 4 pt = ______ c 20.
2 c = ______ oz
21. 1 qt = ______ gal 22. 1 pt = ______ qt 23. 1 c = ______ pt 24.
1 oz = ______ c
25. 3 qt = ______ gal 26. 3 pt = ______ qt 27. 6 c = ______ pt 28.
16 oz = ______ c
29. 1 qt = ______ c 30. 1 pt = ______ gal 31. 1 c = ______ qt 32. 1 gal
= ______ c
33. 1 L = ______ ml 34. 1 kl = ______ L 35. 1 L = ______ kl 36. 1/2 L
= ______ ml
37. 16 qt = 4 ______ 38. 16 pt = 32 ______ 39. 24 pt = 3 ______ 40.
2.5 L = 2500______
41. 3 T = 6000 ______ 42. 1.5 kg = 1500 ______ 43. 6 yd = ______ ft
44. 144 in = _______ft 45. 15 yd = 45 ______ 46. 720 in = 20 ______

Match.

47. 1 meter is a little more than ______ a. 1 fluid ounce
48. 1.5 kilometers is a little less than ______ b. 1 quart
49. 1 liter is a little more than ______ c. 1 yard
50. 30 milliliters is about ______ d. 1 mile

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