Liquid Volume: It's My Party

Strand: Measurement and Geometry

Topic: Measuring liquid volume in U.S. Customary units

Primary SOL: 4.8 The student will
d) solve practical problems that involve length, weight/mass, and liquid volume in U.S. Customary units.

Related SOL: 4.8c

Materials

- 4–5 sets of five different transparent plastic cups of varying sizes and shapes, labeled A, B, C, D, E
- Water
- Food coloring, optional
- 1-gallon container or pitcher
- 1-cup container
- Large tray, such as a cookie sheet or cafeteria tray
- It's My Party Recording Sheet (attached)
- 4–5 plastic measuring cups
- 4–5 sets of three different-sized food containers of varying shapes but with volumes of exactly 1 pint, 1 quart, and 1 gallon, labeled with capital letters A, B, C
- 4–5 plastic storage bins with uncooked rice
- Standard volume-measuring tools, including 1 cup, 1 pint, 1 quart, and 1 gallon
- Paper towels or kitchen towels

Vocabulary

cup, estimate, equivalent, gallon, liquid volume, measure, pint, quart, unit of measure, U.S. Customary system

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Gather four or five transparent (clear) cups in a variety of sizes and shapes. For example, short and wide, tall and thin, or the size of a common drinking glass. Pour one cup of water into each of the transparent cups, and label each cup with capital letters A, B, C, D, and E. As an option, add a few drops of food coloring to the water to make the water easier for students to see. Place these glasses on a tray to allow for any spillage.
2. Display a one-gallon container and a one-cup container. Ask: *"I want to fill a kiddie pool to wash my Labrador retriever. Which container would I use to get the job done quicker? Why?"* Have students turn and talk with a neighbor to discuss. Listen to student discussions, and ask a few volunteers with reasonable justifications to share. Following several justifications, ask, *"What math word or phrase can be used to describe what is being measured in this scenario?"* (liquid volume or volume) Ask students to turn and talk with a neighbor to discuss. Allow enough wait time for discussions, then select a few students to share their words/phrases. Ask students for other examples of when

they use liquid volume. Ask students to share examples of when they would measure liquid volume. As examples are shared, ask students what unit of volume they would use. For example, if a student says, "A glass of soda," ask what unit and how many of the unit would measure the volume of the soda a glass would hold when full.

3. Inform the class that you are having a party. Only a small amount of drinks has been purchased for the party, and you want to use the smallest cups possible so guests will not drink as much. You have some options for cups that can be purchased, and you could use the class's help to determine which cups you should buy. Ask, *"Which cups would be best to buy for the party?"*
4. Place the students into 4–5 groups (depending on class size and how many sets of cups have been prepared). Present the trays with party cup options A, B, C, D, E. Ask students to work together as a group to order the party cup options from least amount of volume to greatest amount of volume. Students should also predict the volume of each of the five party cup options.
5. As a class, have each of the groups share what they determined. Ask a group spokesperson to justify why they thought different party cups would hold less or more than the others.
6. Student observations of the volume of the party cups and their predictions will likely show some misconceptions with conservation of the volume of containers. Often, students won't recognize that the volume of water in the different containers with different heights, widths, and shapes all actually contain the same volume of water. As a demonstration, and to begin a conversation on this concept of conservation, pour the contents of party cup A into a standard measuring cup. Record 1 cup on the board. Pour the water back into party cup A. Dry the measuring cup. Then repeat this process for the contents of party cups B, C, and D. Repeat also for party cup E, but before you empty the water from the party cup into measuring cup, have students make a prediction to determine measurement of party cup E. Students will likely respond that because all of the other party cups only had 1 cup of water, then party cup E will probably contain 1 cup of water also. After confirming party cup E also has a volume of 1 cup, ask, *"What surprised you about the volume of the water in each of the party cups?" "How does this affect what cups I should use at my party?" "How does the size and shape of the cup affect how much it holds?" "What, if any, assumptions can be changed about the volume of liquid in containers of various sizes and shapes?"*
7. Now tell the class that at this same party, you are serving chips and dip. You bought too much dip, so you want the guests to eat a lot of it. You have different containers to hold the dip, but you need their help to determine which container holds the most. Display the three different-sized containers. Tell students they will be working together to determine which container has the greatest volume.
8. Give each group a storage bin of rice, a tray, a plastic measuring cup, a set of three different-sized containers and one copy of the It's My Party Recording Sheet. Ask students to predict first which container will hold the most. Ask students to make an estimate as to how much volume each container holds and record predictions on the recording sheet.

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9. Next, ask students to work together to use the standard measuring cup to precisely measure and count the number of cups of rice that will fill each of the three container options for dip. Discuss that the container should be filled to the rim with rice.
10. Once the measurements in cups are completed and recorded on the recording sheet, ask students to share the measurements, in cups, of the three dip containers. Ask, *"What would be another unit of measurement that we could use for volumes of two cups or more?"* After suggestions, show that two cups will fit into the standard pint container by pouring the two cups of rice into the pint. Then ask students to explore the following. *"Which of the other standard volume measurement containers could possibly be equivalent in size to the amount of cups in each of the other two containers?"* Allow students to determine that there are by pouring the different containers of rice into the standard liquid volume containers.
11. As closure to the discussion, have the class help make an anchor chart for liquid volume equivalences among cups, pints, quarts, and gallons. Draw a chart such as the one below to start the anchor chart, leaving white sections blank. Ask for estimates for each of the sections of the chart before demonstrating pouring the volumes of rice into the standard measurement containers and noting the actual equivalencies in the blank sections of the chart.

	Cups (c)	**Pints (pt)**	**Quarts (qt)**	**Gallons (gal)**
Cups	----------	1 pt = 2 c	1 qt = 4 c	1 gal = 16 c
Pints	2 c = 1 pt	----------	1 qt = 2 pt	1 gal = 8 pt
Quarts	4 c = 1 qt	2 pt = 1 qt	----------	1 gal = 4 qt
Gallons	16 c = 1 gal	8 pt = 1 gal	4 qt = 1 gal	----------

Facilitate a discussion where students share what they notice about the equivalency chart. Have students make connections to volumes of containers they have seen in their own kitchen or at a grocery store that is sold in each unit of volume or more than one unit of volume (e.g., milk in cups, pints, quarts, and gallons). Real-life examples such as these will provide visual references for students.

12. Students can work in their groups to complete the reflection questions on the It's My Party Recording Sheet after the discussion.

Assessment

- **Questions**
  - Have students complete their own recording sheet for the lesson, so they can complete the reflection questions independently.
  - A restaurant has two full pint containers of onion in their refrigerator. Most of their recipes call for 1 cup of onion at a time. How many cups of onion does the restaurant have? Quarts? How could this volume be expressed in gallons?
  - Kate bought a container of ice cream. She noticed that the label says that there are 2 quarts of ice cream in the container. How many 1-cup servings are in the container of ice cream?

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  - If a container holds 2 gallons, what are some other ways to describe how much it holds?
  - A gallon container is only half full. How many quarts is equivalent to this volume? Pints? Cups?

- **Journal/writing prompts**
  - Find objects in the classroom that have volumes close to the following measurements: 2 cups, 4 quarts, 2 gallons, 4 pints, 8 cups. For as many measurements as possible, express an equivalent measurement using a different unit of volume.
  - Your teacher's doctor recommended that she drink 16 cups of water a day. What size container should she carry to work, and why do you recommend that size?

- **Other Assessments**
  - Monitor group discussions during the lesson to determine familiarity with relative sizes of units of volume and the ability to use standard measurement tools to precisely measure volume.
  - As an exit ticket, have students explain why a short glass may not hold a smaller volume of liquid than a tall skinny glass.
  - Look through your refrigerator, cabinets, and/or garage at home. Find several containers which have volumes listed on their labels. Make a list of items and the measure each container holds.

Extensions and Connections (for all students)

- Students create a bar graph, displaying the different volumes of the containers in the activity.
- Students create a measurement experiment that incorporates Science SOL 4.1c.
- Students can create an equivalences chart for teaspoon and tablespoon.

Strategies for Differentiation

- Use containers with extreme discrepancies in their volumes so that it is more apparent which likely the largest volume.
- Provide an equivalency chart for students when they are required to determine equivalent measures of liquid volume.
- Create an anchor chart that shows pictures and examples of the different liquid volume units of measurement.
- Give students containers that are close in volume to make estimating and predicting more difficult.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

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It's My Party Recording Sheet

Which container do you think would be best to use for the party dip? Why?

Record the measurements of each possible party dip container in the table.

	Estimated Measurement (in cups)	**Actual Measurement** (in cups)
Container A		
Container B		
Container C		

<u>Reflection Questions</u>

Which container should be used to serve the dip? Why?

Explain how previous experiences with measuring volume were used to make your estimate for the volume of each container for the dip.

How did your estimated volumes and actual volumes differ? How would you change your estimates after completing this work?

What are some equivalent measurements that were discovered for the actual container volumes in pints, quarts, and gallons?

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