Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_\_

**Accuracy and Precision of Glassware Lab**

**Essential Question:** Which piece of glassware would be “best” for measuring volumes in a chemistry lab class?

**Hypothesis:** ­­­­­­­­­­­­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Materials**

* 100 mL beaker
* 10 mL graduated cylinder
* 100 mL graduated cylinder
* 250 mL Erlenmeyer flask
* electronic balance
* 2 Plastic beakers for water

**Procedure**

1. Fill your plastic beaker with approximately 200mL of water. You will use this to pour water into your glassware. (Trying to fill the glassware directly from the faucet can cause the glassware to slip out of your hand and break in the sink – *uh oh!)*
2. Obtain the 4 pieces of glassware listed in the materials section.
3. Choose a piece of glassware to start with—you will each use them all! Use the glassware to measure out exactly 50 mL of water. *Note: the small graduated cylinder will need to be done in increments of 10 mL, then transferred to a larger container.*
4. Record the exact volume under “measured volume” with the correct number of significant figures.
5. Place an empty plastic beaker on the electronic scale, then press the zero button. Pour the volume of water you measured into the empty plastic beaker. Record the mass of the water in your data table.
6. Pour the water from the scale back into your plastic beaker (from step 1), and repeat steps 3-5 for each piece of glassware (each person should use each tool once and record their measurements in their data table!).
7. Complete your data tables by calculating the volume of water for each trial. Determine the “calculated volume of water” by multiplying the mass of water by the density of the water (this is because volume = mass x density!)
8. Record your calculated volumes in the group data table, then Average together everyone’s volume and record in the “data & analysis” section below.

**Data Table:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

| **Glassware** | **Measured Volume (mL) *(sig figs!)*** | **Mass of Water (g)** | **Density of Water** | **Calculated Volume of Water (mL)** |
| --- | --- | --- | --- | --- |
| 100 mL beaker |  |  | 1.0000 g/mL |  |
| 10 mL graduated cylinder |  |  | 1.0000 g/mL |  |
| 100 mL graduated cylinder |  |  | 1.0000 g/mL |  |
| 250 mL Erlenmeyer flask |  |  | 1.0000 g/mL |  |

**Data & Analysis: Combine the data from your group (averages) to fill in the table below.**

| **Glassware** | **Expected (Theoretical)** | **Average Calculated Volume (Actual)** | **% Error** |
| --- | --- | --- | --- |
| 50 mL volumetric flask(class example) | 50 mL |  |  |
| 100 mL beaker | 50 mL |  |  |
| 10 mL graduated cylinder | 50 mL |  |  |
| 100 mL graduated cylinder | 50 mL |  |  |
| 250 mL Erlenmeyer flask | 50 mL |  |  |

**Sample Calculations**

Percent error is a way of calculating how close your measurements or results were to an actual or accepted answer. A lower percent error means that your results were very close (accurate), a higher percent error means that your results were not very close (accurate). The formula for percent error is given below. Use the formula to calculate the percent error for each piece of glassware. Show one sample calculation below.

$$Percent Error= \frac{\left|actual-theoretical\right|}{theoretical}×100=$$

**Discussion Questions**

1. Which piece of glassware is most accurate?

Claim: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Evidence: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Reasoning: *(Remember—The evidence shows…I know (scientific facts)…I can apply (big ideas/connect your ideas together)…Therefore…)* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. For each of the following situations, determine which type of glassware would be most appropriate. (100mL beaker, 100mL graduated cylinder, 250mL Erlenmeyer flask) Each will be used only once. *Note: When working with laboratory glassware, scientists choose the glassware that is appropriate while also efficient for the experiment. For example, if an experiment calls for using approximate volumes, it would be a waste to carefully measure out the volumetric flask.*
	1. A lab calls for dissolving 5g of NaCl in *approximately* 150mL of water. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. A lab calls for adding *approximately* 50mL of water to a solution. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. A lab calls for adding 50.0 mL of water to a solution. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_