

 **Activity 3.1.4 Measure Me****Purpose**

Working in a science-related field not only requires the use of many specific tools, but also the ability to make precise and accurate measurements. The success of many laboratory experiments and your safety rely on your ability to read procedures carefully and follow them accurately. Following procedures often includes measuring a variety of compounds.

Measurements commonly used in the laboratory include distance, mass, temperature, and volume. These can be measured using the metric or English system. See Figure 1 for comparable units of measurement.

<b>Unit</b>	<b>Metric</b>	<b>English</b>
<b>Distance</b>	Centimeters	Inches
<b>Mass</b>	Grams	Ounces
<b>Temperature</b>	Degrees Celsius	Degrees Fahrenheit
<b>Volume</b>	Milliliters	Ounces

**Figure 1. Units of Measurement**

An additional measurement used in the laboratory is density. Density is the mass or weight of an object in comparison to its volume. Consider a brick compared to a like-sized piece of Styrofoam, the brick is much heavier even if they are the same size. While the volume of the brick is similar to the volume of the Styrofoam, the density of the brick is much greater.

Measuring accurately is like putting a puzzle together. Once you put all the pieces in the right place, you end up with a rewarding end product. Can you measure length, mass, temperature, volume, and density accurately in order to put the pieces of this lab together correctly?

**Materials****Per group class:**

- Water
- 4 staplers
- 4 electronic balances
- 4 600ml beakers
- 4 thermometers
- 4 hot plates
- 4 thermal protective cloths
- Microwave

**Per student:**

- Paper
- Ruler
- Scissors
- 30cm masking tape
- Safety glasses
- Disposable gloves
- Lab apron
- 100ml beaker
- 100ml graduated cylinder
- 34g chemical powder
- Plastic spoon
- Weighing dish
- Stirring rod
- Pencil
- *Agriscience Notebook*



## Procedure

You will use a variety of measurement methods to mix chemicals. Take care to measure correctly and follow procedures in order to produce the correct mixture. Read all procedures prior to beginning the lab.

### Part One – Linear Measurement

1. Obtain a piece of paper from your teacher.
2. Use a ruler and pencil to draw a fifteen-centimeter square in the center of the paper.
3. Divide the paper into nine 5cm<sup>2</sup> squares as shown in Figure 2. Use caution to be very accurate with your measurement.
4. Label the lines within your square as shown in Figure 3.
5. Write your name on the base and top center square.
6. Cut out the 15cm<sup>2</sup> square.
7. Cut the appropriate lines within the square.
8. Make the appropriate folds as indicated by your markings. Be sure the marking side is to the outside of the box.
9. Place a staple at the top of each side of the container.
10. Tape the outside corners to seal the edges.

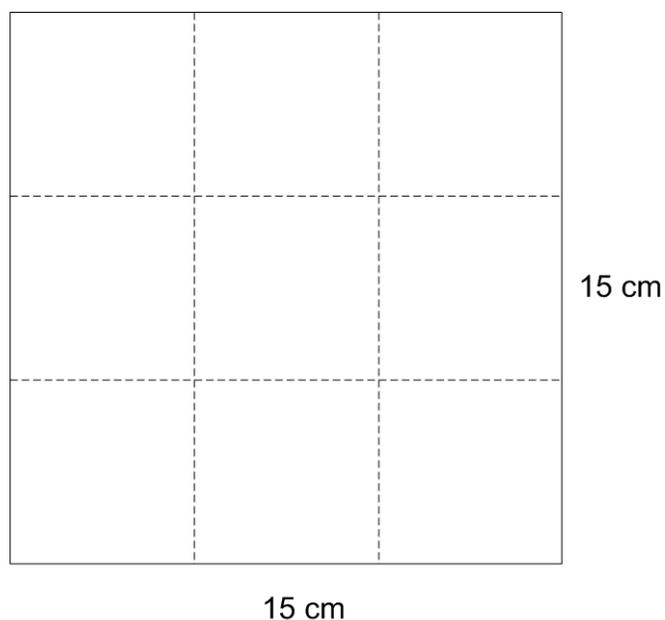


Figure 2. Nine Square Box

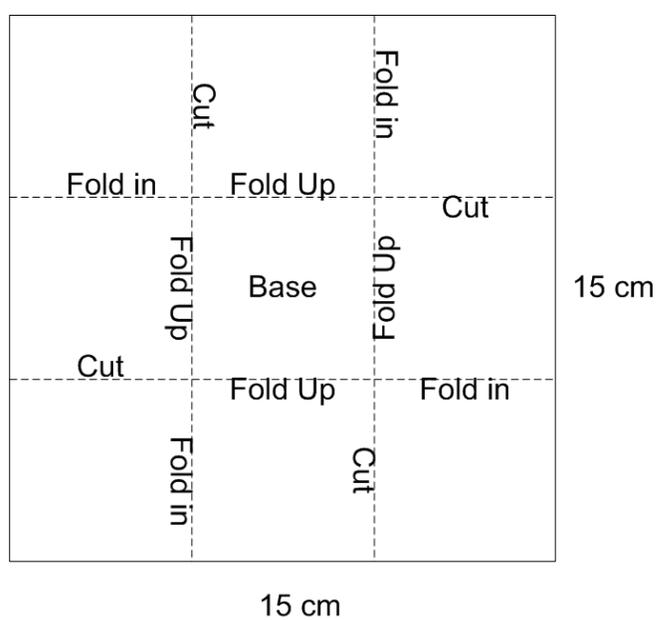


Figure 3. Labels

### Part Two – Determining Mass

As you are working with chemical compounds, personal protective equipment is required for the remainder of this lab.

1. Put on your safety glasses, gloves, and lab apron.
2. Collect a spoon and weighing dish.

- Use the electronic balance to determine the mass of the empty dish and record here. Include the correct units of measurement. \_\_\_\_\_
- Use the spoon to add 34 grams of the dry powder to the dish.
- Carefully pour the powder into the 100ml beaker.

### Part Three – Taking Temperature

- Use one of the 600ml beakers to heat approximately 100ml of water to boiling on a hot plate or in a microwave.
- Once the water is boiling, use the thermometer to determine the temperature of the water. Record here.  
\_\_\_\_\_ 98 \_\_\_\_\_

### Part Four – Adding Volume

- Using a thermal protective cloth, measure 60ml of boiling water into the graduated cylinder.
- Quickly pour the water into the 100ml beaker with the chemical powder. Take care not to spill the water.
- Use the stirring rod to mix the compounds until the powder is completely dissolved.
- Allow the mixture to cool for ten minutes by monitoring the clock or your watch.
- While waiting, clean up your workstation.
- After ten minutes have passed, pour the mixture into the paper container you made in Part One.
- Place the container in the refrigerator as instructed by your teacher.

### Part Five – Determining Density

- Put on personal protective equipment including safety glasses and gloves.
- Obtain your container and a piece of wax paper from your teacher.
- Use the electronic balance to measure the mass of the wax paper and record the result in Table 1.
- Peel the paper container away from the now solid mixture in the container and place the solid on the wax paper.
- Use the electronic balance to measure the total mass of the solid and the wax paper and record in Table 1.
- Subtract the mass of the wax paper from the total mass to calculate the mass of the solid and record in Table 1.
- Use the ruler to measure the length, width, and height of the solid and record in Table 1.
- Calculate the volume of your cube by multiplying the length times the width times the height and record in Table 1.

$$\text{Volume (cm}^3\text{)} = \text{length}(l) \times \text{width}(w) \times \text{height}(h)$$

- Calculate the density of the solid by dividing the mass of the solid by the volume of the solid. Record in Table 1.

$$\text{Density (g/cm}^3\text{)} = \frac{\text{Mass (g)}}{\text{Volume (cm}^3\text{)}}$$

<b>Example: Water</b>	
Density =	$\frac{1 \text{ g (Mass)}}{1 \text{ cm}^3 \text{ (Volume)}}$

10. Dispose of all materials as instructed by your teacher.

**Table 1. Results (include units for all data)**

<b>Mass</b>	Wax Paper:1.5g	Total:22.7g	Solid:21.2g
<b>Measurement</b>	Length:5 cm	Width:5 cm	Height:1 cm
<b>Volume (L x W x H):</b>	25 cm <sup>3</sup>	<b>Density (Mass/Volume):</b>	0.848 (g/cm <sup>3</sup> )

## Conclusion

1. List three measurements that were essential to the success of this experiment.  
grams, centimeters, millimeters
2. What problems could inaccurate measurements have caused when building your cube?  
parts of the substance that is not level and higher or longer in certain parts
3. Describe one everyday application for each type of measurement.
  - Distance- how far you go in a car that day
  - Mass- how heavy you crops are
  - Temperature- how cold it is outside
  - Volume- how much space something takes to store it
  - Density- comparing different densities of how much an animal needs
4. What is the density of an item that has a mass of 10 grams and a volume of 10 milliliters?  
the density is 1 (g/cm<sup>3</sup>)