Name: _____

CASE

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.

Unit	Metric	English
Distance	Centimeters	Inches
Mass	Grams	Ounces
Temperature	Degrees Celsius	Degrees Fahrenheit
Volume	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 class:

- Water
- 4 staplers
- 4 electronic balances
- 4 500 ml beakers
- 4 thermometers
- 4 hot plates
- 4 thermal protective cloths

Per student:

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

Procedure

You will be using a variety of measurement methods to mix chemicals. Take care to measure correctly and follow procedures in order to produce the correct mixture.

Part One – Linear Measurement

1. Obtain a piece of paper from your teacher.
2. Draw a fifteen centimeter square in the center of the paper.
3. Divide the paper into nine 5 cm^2 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 15 cm^2 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.

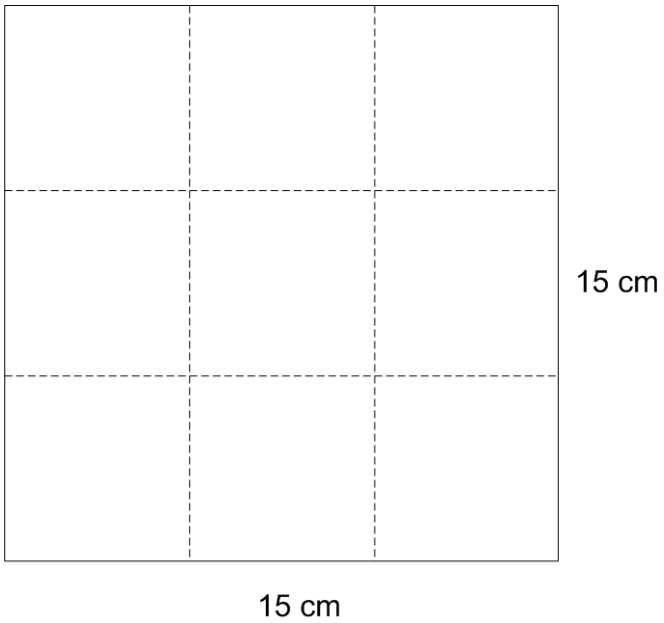

***Figure 2*. Nine Square Box**

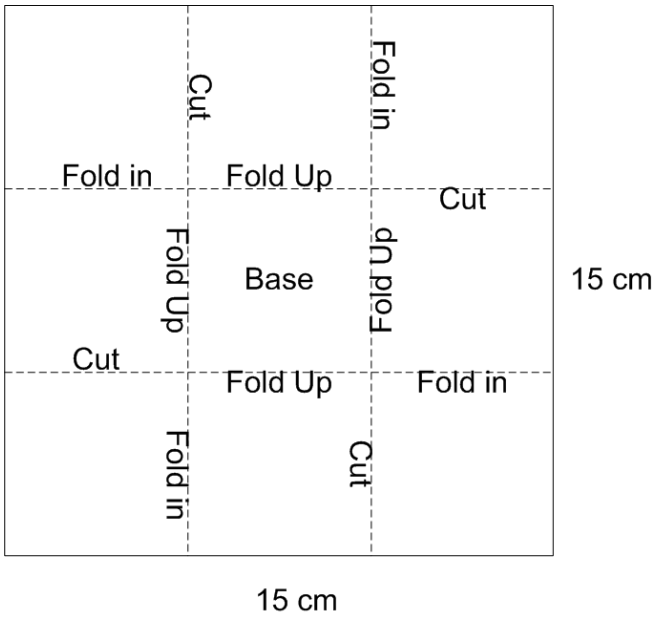

***Figure 3*. Labels**

Part Two – Determining Mass

As you will be 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.

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

Part Three – Taking Temperature

1. Use one of the 500 ml beakers to heat water to boiling on a hot plate.
2. Once the water is boiling, use the thermometer to determine the temperature of the water. Record here. _____

Part Four – Adding Volume

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

Part Five – Determining Density

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

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

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

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

Example: Water

$$Density = \frac{1\ g\ (Mass)}{1\ cm^3\ (Volume)} \quad 1\ g/cm^3$$

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

Table 1 ***Results (include units for all data)***			
Mass	Wax Paper:	Total:	Solid:
Measurement	Length:	Width:	Height:
Volume (L *x* W *x* H):		**Density (Mass/Volume):**	

Conclusion

1. List three measurements that were essential to the success of this experiment.

2. What problems could inaccurate measurements have caused when building your cube?

3. Describe one everyday application for each type of measurement.
    - Distance
    - Mass
    - Temperature
    - Volume
    - Density
4. What is the density of an item that has a mass of 10 grams and a volume of 10 milliliters?