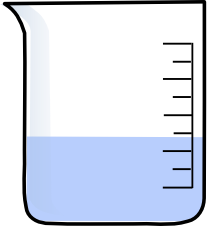
**Directions:** This investigation requires you to use various scientific tools to measure volume, mass, and dimensions of objects. Please apply your knowledge of using science equipment to the following procedure. Be sure to answer all questions. Submit your completed assignment via teams

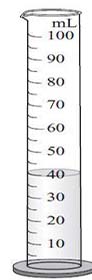
*Materials:  Pipette, graduated cylinder, ruler, meter stick, beaker, water, balance (scale), marbles, empty plastic food container, calculator, plastic cups*

**Part A – Measuring Volume of a Liquid**

**Volume** is the amount of space that an object occupies or that can be enclosed in a container.  Liquids have volume that is measured using a beaker, a graduated cylinder, or a pipette.

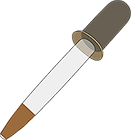
A **beaker** is a large glass container, usually having a pour spout.  The beaker will have lines on the outside with a measurement and a number that tells you the total amount that can be held within.

1. How much liquid can your beaker measure? \_\_\_\_\_\_\_
2. Partially fill a plastic cup with water and then empty it into the beaker.   What volume of water did you fill in the cup?   \_\_\_\_\_\_\_\_\_\_\_\_



A **graduated cylinder** also measures volume and is a bit more accurate than a beaker. Examine your graduated cylinder and note the numbered marks. Examine the liquid *at eye level* to see where it is at the mark.  There may be a noticeable curve in the liquid (called the meniscus). You should take your measurement at the bottom of this curve

1. How much liquid can your graduated cylinder hold?   \_\_\_\_\_\_\_\_\_\_
2. Partially fill the plastic cup again and then carefully pour it into the graduated cylinder. What volume of water did you fill in the cup? \_\_\_\_\_\_\_\_\_\_\_\_



**Pipettes** are also used to measure volume, though usually only a small amount of volume can be used.  Examine the plastic pipette at your station.

1. How much liquid can it measure? \_\_\_\_\_\_\_\_

**Investigate:** How can you measure the number of drops in a single milliliter of water? Discuss or chat with your partner how you can use the tools provided to answer the question. Provide a specific detailed procedure for measuring the number of drops in a single milliliter of water.

Step 1:

After developing your procedure, follow it, do the lab!!

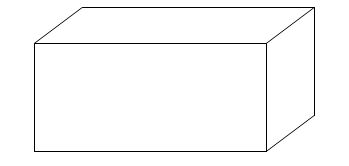
1. How many drops of water are in a single milliliter?  \_\_\_\_\_\_

**Part B – Measuring Volume of a Container**

Solid objects have a volume.  Recall that volume refers to how much space an object takes up.

For symmetrical objects, volume is simply LENGTH x WIDTH x HEIGHT      

Use a metric ruler to measure the box below and determine its volume (measure in cm)

Length = \_\_\_\_\_\_\_\_\_\_\_\_ Width = \_\_\_\_\_\_\_\_\_\_\_\_\_ Height = \_\_\_\_\_\_\_\_\_\_\_\_\_

1. The volume of the box is: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

You can also determine the volume of a box-shaped container (like plastic food storage containers) using the same method.   Obtain a storage container and measure the length, width and height.

Length = \_\_\_\_\_\_\_\_\_\_\_\_ Width = \_\_\_\_\_\_\_\_\_\_\_\_\_ Height = \_\_\_\_\_\_\_\_\_\_\_\_\_

1. Calculate the volume of the container L x W x H (depth) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Fill your container with water, then carefully pour the water out into a graduated cylinder or beaker.

1. What volume of liquid does the container hold?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Is the volume from measuring similar to the volume from filling it with liquid?    Explain any differences.

For oddly shaped objects, a **water displacement technique** can determine the volume.

Find the volume of 3 marbles by filling a graduated cylinder to 20 ml. Drop the marbles in and see how much the water rises – this is the volume of the marbles. Complete the table below.

|  |  |  |
| --- | --- | --- |
| **Volume of Water before adding marbles** | **Volume of Water after adding 3 marbles** | **Calculate (B minus A)  Volume of all 3 marbles** |
| *20 ml (starting volume)* |  |  |

1. Now determine the volume of a single marble by **dividing your total (above) by 3**. \_\_\_\_\_\_\_\_\_\_\_
2. Drop a *single* marble into the graduated cylinder. What is its volume? \_\_\_\_\_\_\_\_\_\_\_\_

**Part C – Measure Length in Metric Units**

The three units of length we will use are:  millimeters, centimeters, and meters.

1. Use a meter stick to determine:   How many mm are in a cm?  \_\_\_\_\_\_\_\_
2. How many cm are in a m? \_\_\_\_\_\_\_\_\_

Use a meter stick or ruler to fill out the table below. (If the area is shaded, do not complete)

|  |  |  |  |
| --- | --- | --- | --- |
|  | In millimeters | In centimeters | In Meters |
| Height of lab table |  |  |  |
| Length of lab table |  |  |  |
| Width of door |  |  |  |
| Your height |  |  |  |
| Height of graduated cylinder |  |  |  |
| Length of pipette |  |  |  |
| Length of your shoe |  |  |  |

Determine which measurement is larger. Highlight your answer.

1. 14 mm or 1 cm
2. 145 m  or 145 km
3. 334 m   or   1 km
4. 3.4 cm or 30 mm
5. 1 m  or 990 cm

Highlight the BEST metric unit for example

1. The length of an eyelash [  mm  cm   m   km ]
2. The height of a flagpole [  mm  cm   m   km ]
3. The length of your arm [  mm  cm   m   km ]
4. The distance between Chicago and St Louis [  mm  cm   m   km ]

**Part D: Mass of Objects**

We will be measuring mass using grams. Be sure to TARE or zero out your balance *before* placing anything on the balance. To measure the mass of an object that cannot sit flat on the balance, first measure the mass of the *empty container*, then add the object. The mass of the object is the difference in mass that is observed.

1. Determine the mass of 20 ml of water. First measure the mass of a Graduated cylinder \_\_\_\_\_\_
2. Then measure the mass of the Graduated Cylinder + 20 ml of water \_\_\_\_\_\_
3. Calculate the mass of 20 ml of water \_\_\_\_\_
4. Use the same technique to determine the mass of 50 ml of water: \_\_\_\_\_\_\_\_\_\_\_
5. Use the same technique to determine the mass of 1 marble: \_\_\_\_\_

**Analysis:**

1. What three tools are used to measure the volume of a liquid?

1. Explain why a graduated cylinder is more accurate than a beaker.

1. Explain how you could measure the **volume** of a toy dinosaur.  Use scientific terms for the tools you would use.
2. In science, metric units are used.  Which unit is used for:

Volume? \_\_\_\_\_\_\_             Mass? \_\_\_\_\_\_             Length?  \_\_\_\_\_\_\_\_\_\_

**OPTIONAL MIND BUSTER:**

A tub holds 5000 liters of water. The tub is filled with 4000 liters of water. An object with a volume of 1100 liters, a mass of 60 kilograms, and a height of 120 cm is dropped into the tub. Will the water overflow?   **Explain** your answer.