MEASUREMENT AND METRICS
I. Metric System

A. Advantages
   o ________________ – You never need to use fractions to express parts of a unit.
   o Based on units of 10
   o Used worldwide
   o Uses prefixes to change the size of the unit… Kilo, Hecto, Deca, Deci, Centi, Milli

B. Base Units in the Metric system include:

   1. __________________________ – measures length
      a. Tool – __________________________
         • My hand span is _____ . ___ centimeters. (Measure your outstretched hand between tip of thumb and tip of little finger)
         • The width of my fingernail is _______.____ cm or ______ mm.
         • The width of the back my hand is _______ . ____ cm.
         • My height is _________. ___ cm.

   2. __________________________ – measures volume
      a. __________________________ is the amount of space an object takes up.
      b. Tool – __________________________
         o Read the graduated cylinder to the bottom of the __________________________ (dip in the water’s surface)
The volume of a **regularly shaped object** is measured in **Cubic centimeters**. The length of each side is measured in centimeters and the following formula is then used:

\[
Volume = \text{Length} \times \text{Width} \times \text{Height}
\]

1 ml = 1 cm³

c. The ___________________________ method can be used to find the volume of an irregularly shaped solid. Pour a specific volume of water into a graduated cylinder; drop an object into the water, read the volume again. The difference is the volume of the object.

3. ___________________________ – measures mass
   a. **Mass** is the amount of __________ in an object
   b. Tool – ___________________________

4. ______________ – measures weight
   a. **Weight** is how much gravity is pulling on an object
   b. Tool - scale

5. **Celsius** – measures temperature
   a. Boiling point of water = 100 °C
   c. Freezing point of water = 0 °C
   d. Body temperature = 37 °C
   e. Use this poem to help visualize the Celsius scale:
      o Thirty is hot
         Twenty is nice
         Ten is chilly
         Zero is ice
Converting Metric Units

1. Fill in the chart.

2. Identify the unit you are beginning with.

3. Place your finger on the chart by the original unit.

4. Count the number of spaces you have to move to get to the new unit.

5. What direction did you have to move?

6. Move the decimal point the same number of spaces and in the same direction as you moved your finger on the chart.

7. Add zeros to hold the place value.

Examples

1. 1 m = __________ cm

2. 10 mm = _______ dm

3. 245.6 m = _______ km
Metric Mania Conversion Practice

Metric System

King
Kilo-
Henry
Hecto-
Doesn't
Deka-
Usually
UNIT
- Meter
- Gram
- Liter

Drink
Deci-
Chocolate
Centi-
Milk
Milli-
Try these conversions, using the ladder method.

1000 mg = ______ g
1 L = ______ mL

160 cm = ______ mm
14 km = ______ m

109 g = ______ kg
250 m = ______ km

Compare using <, >, or =.

56 cm  circle  6 m

7 g  circle  698 mg
Lab: Measuring Length

Name ____________________________

Class ____________ Date ___________

Background information: The metric system is the international system of measurement. It is used world-wide by scientists to make it easier to communicate. The system combines prefixes and base units to define larger and smaller quantities.

Directions: Use the chart on the board to fill in the chart below.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Abbreviation</th>
<th>Value (factor)</th>
<th>Combined abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Meter</td>
</tr>
<tr>
<td>Kilo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deka</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deci</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milli</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Use your meter stick to answer the questions below.
   
a. 1 m = __________ cm
   
b. 1 cm = __________ mm
   
c. 1 m = __________ dm

2. Use a metric ruler or meter stick to find each measurement.
   
(a) Length of the line in centimeters. __________
(b) Length of the line in millimeters. __________

(c) Height of the rectangle in centimeters. __________
(d) Width of the rectangle in centimeters. __________

(e) Radius of the circle in millimeters. __________
(f) Diameter of the circle in centimeters. __________
3. Find the length of an unsharpened pencil (including the eraser) in millimeters. __________
4. What is your height in centimeters? __________
5. What is your height in meters? __________
6. Find the distance between the two index cards in the hallway in meters. __________
7. Circle the BEST metric unit for each.

   (a) The length of an eyelash: mm cm m km
   (b) The height of a flagpole: mm cm m km
   (c) The length of a strand of spaghetti mm cm m km
   (d) The distance from Buffalo to Chicago mm cm m km
Purpose: To become familiar with the use of the triple beam balance to measure mass.

Materials: Balance, 4 pennies, wood block, marble, graduated cylinder, eraser

Procedure and Observations:

1. Obtain a triple beam balance. Remember the proper way of carrying the balance.

2. Familiarize yourself with the operation of the balance before you begin.

3. Make sure the balance has been zeroed.

4. Find the mass of the objects and write their masses in the data table below.

<table>
<thead>
<tr>
<th>Object</th>
<th>Mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper clip</td>
<td></td>
</tr>
<tr>
<td>4 pennies</td>
<td></td>
</tr>
<tr>
<td>Marble</td>
<td></td>
</tr>
<tr>
<td>Block of wood</td>
<td></td>
</tr>
</tbody>
</table>

5. Find the mass of an EMPTY graduated cylinder. Record the mass in the table below.

6. Add 25 ml of water to the empty graduated cylinder and find the mass of the graduated cylinder with the water. Record this number in the table.
7. Find the mass of the water alone.

<table>
<thead>
<tr>
<th>Mass of the empty cylinder (g)</th>
<th>Mass of the cylinder and water (g)</th>
<th>Mass of the water alone (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Questions and Conclusions**: Use complete sentences.

1. Define mass.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. Define weight.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. Why is it important to zero out the balance?

________________________________________________________________________
________________________________________________________________________

**Big Brain Bonus**

Explain why the weight of an object can change while its mass stays constant?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Measuring Mass Practice
Lab: Volume

**Purpose:** To measure how much space objects occupy.

**Materials:** Graduated cylinders, beakers, water, wood block, 4 pennies, washers, 5 marbles

**Procedure and Observations:**

1. What units of measurement do your graduated cylinders use?  
   
   ______________________

2. What is the formula for finding the volume of a regular object?  
   
   Volume = ____________________

3. Find the volume of a block. Label your answer correctly!!!
   
   a. The length of the block is  
   ______________________
   b. The width of the block is  
   ______________________
   c. The height of the block is  
   ______________________
   d. Using the formula in #2, find the volume of the block.  
   ______________________

4. What is the method used for finding the volume of an irregularly shaped object?
   
   ______________________________________

Procedures of experiment

a. Add 25 ml of water to a graduated cylinder. Record this volume in the chart below.

b. Carefully place 5 marbles into the cylinder with water. Record the new volume on the chart.

c. Subtract the original volume from the final volume. This is the volume of the marbles. Record this information in the proper place on the chart.

d. Using the same procedure, find the volume of the pennies and the washers.
<table>
<thead>
<tr>
<th>Object</th>
<th>Original volume of water</th>
<th>Final volume of water and object</th>
<th>Volume of the object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marbles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 pennies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Conclusions:**

1. Define the following words:
   
   a. volume- ____________________________________________________ 
      __________________________________________________________________
   
   b. meniscus- ____________________________________________________ 
      __________________________________________________________________

2. What is the unit of measure for liquid volume? _________________________________

3. What is the unit of measure for volume of a regularly shaped object? _______________

4. What is the name of the method used to measure the volume of irregular solids? 
   ___________________________________________________________________
**Background:** The base unit of length in the metric system is the meter. A meter is broken up into smaller segments called a decimeter, centimeter, and millimeter. A decimeter is 10 times larger than a centimeter. A millimeter is 10 times smaller than a centimeter.

**Purpose:** You will measure using a metric ruler and accurately record measurements taken in centimeters and millimeters.

**Materials:** rulers, yarn, smiles

**Procedure:**
1. Take a piece of yarn and measure your partner's smile straight across from corner to corner.
2. Keep your fingers on the yarn as you transfer the yarn to the ruler.
3. Record measurements, cm and mm, in Table 1
4. Throw yarn away.
5. Place data on the Class Stem and Leaf.

**Data**

<table>
<thead>
<tr>
<th>Table 1: Smile Length</th>
<th>cm to the nearest .1</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>My smile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>My partner’s smile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Summary of class data</th>
</tr>
</thead>
<tbody>
<tr>
<td>max</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>Smile in cm</td>
</tr>
</tbody>
</table>

**Analysis/Results:**

1. What was the largest smile? __________cm __________mm
2. Smallest? ________________cm ________________ mm
3. Add up all of your smiles. How big is our class smile? ________________ cm ________________ mm
4. How many centimeters are in a meter? ________________ Millimeters? ________________
<table>
<thead>
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<th>Value (factor)</th>
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</thead>
<tbody>
<tr>
<td>Kilo</td>
<td>k</td>
<td>1000</td>
<td>km</td>
</tr>
<tr>
<td>Hector</td>
<td>h</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Deka</td>
<td>da</td>
<td>10</td>
<td>daL</td>
</tr>
<tr>
<td>Deci</td>
<td>d</td>
<td>0.1</td>
<td>dg</td>
</tr>
<tr>
<td>Centi</td>
<td>c</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Milli</td>
<td>m</td>
<td>0.001</td>
<td>mm</td>
</tr>
</tbody>
</table>