ACTIVITY 1-1: **THE CENTIMETER**

OBJECTIVE(s): After completing the activity, students will be able to:

▷ measure lengths in centimeters.

MATERIALS:	
30 Student Activity Sheet 1-1A, Metric Cube	15 rolls clear tape
30 Centimeter Ruler Patterns	30 scissors
30 Student Activity Sheet 1-1B, Centimeter Ruler	
30 Student Activity Sheet 1-1C, Square Centimeters	
30 Cubic Centimeter Patterns	

BACKGROUND INFORMATION:

The metric system is a standard system of measurement used worldwide by the scientific community. The United States is one of two countries that still use the English system of measurement for everyday uses. The metric system is a decimal system based on the number ten. This system is used to measure length, volume, mass, and temperature. The base unit of length is the meter (m), derived from the Greek word *metron*, meaning "to measure". A meter is one ten-millionth of the distance between the equator and the North Pole. The volume of an object is measured in liters (L) and cubic centimeters (cm^3 or cc). Metric mass is measured by the units grams (g) or kilograms (Kg). One kilogram equals 1,000 grams. Temperature is measured in degrees Celsius (°C). The metric system came into existence after the French Revolution. The new government decided to produce a rational set of units for all measurements, the everyday, as well as those used in science and technology.

PROCEDURE:

1. Students will be making a centimeter cube to measure the lengths of various objects. Give each student a **Cubic Centimeter Pattern** and **Student Activity Sheet 1-1A, Metric Cube.**
2. Students should follow directions provided on Activity Sheet 1-1A to make their metric cube and finish the activity. The first two activities (1-1A, 1-1B) focus on linear measurement.

(WRITE ON BLACKBOARD: centimeter = cm.)

3. Give each student **Student Activity Sheet 1-1B, Centimeter Ruler** and **Centimeter Ruler Pattern.**
4. Student should follow directions provided on Student Activity Sheet 1-1B to make their centimeter rulers and complete the activity. (Be sure to put out small objects for measurement.)
5. Give each student **Student Activity Sheet 1-1C, Square Centimeters** to each student.
6. Students should follow directions provided on Student Activity Sheet 1-1C. Students should use their centimeter rulers to measure the area of the rectangular shapes. Students can find the area by counting how many square centimeters each shape contains. Show them how they can also determine these areas by arithmetic (length x width).

ACTIVITY 1-2: **METRIC GUESSING GAME**

OBJECTIVE(s): After completing the activity, students will be able to:

▷ estimate using a metric unit for length (centimeters).

MATERIALS:
Bag of the following items: pencil, nail, large & small paper clips, marble, pink eraser, pack of gum, plastic spoon, penny, straw, nickel, bar of soap, film canister.
Markers (50 poker chips)
* Using different science equipment for examples is another idea, i.e. length of a beaker.
** Students will need to use their metric cube and ruler to complete this activity.

PROCEDURE:

1. Students should work in teams of 5. Game can be set up in the "family feud" format. Have two teams compete against each other. Depending on the time, you can have two teams compete at a time or have 3 competitions going at once (based on class of 30).
2. Instructor should hold up an object, asking the teams to estimate the length or width of the item in centimeters. Students can only use their metric cube and ruler for help in estimating, however, they cannot use them to measure the item. Each team will need to come up with one estimation and write it down on a piece of paper. Then, have one student from each team measure the object and come up with an answer (have students use a metric ruler). Both students have to agree with the answer. The team with the closest answer receives the point or marker. The team that has the most markers after 7 items advances to the next competition.
3. The teams that have been eliminated during the first round will compete against each other in a second-chance competition. This will make it possible for all students to be participating during the game.
4. Using science equipment as items for length/width estimation would be an excellent way item for students be become familiar with the equipment that they will be using throughout the camp.

ACTIVITY 1-3: **MAKING MASS SETS**

OBJECTIVE(s): After completing the activity, students will be able to:

- ▷ use balances to measure mass in grams.
- ▷ give an example to distinguish the difference between mass and weight.

MATERIALS:	
30 Student Activity Sheet 1-3, Making Mass Sets	10 balances
180 black, film canisters with lids (6 per student)	15 laboratory scoops
180 adhesive labels	30 large rubber bands
10 brass mass sets	sand -10 lbs
30 - 9 oz plastic cups	15 black Sharpee pens
300 large paper clips (10 per student)	

BACKGROUND INFORMATION:

Matter is anything that has mass and takes up space (volume). **Mass** is the amount of matter (stuff) present in an object. The **weight** of an object is the response of mass to the pull of **gravity** (the force of attraction between all objects in the universe). The mass of an object always remains the same while the weight is depends on the gravitational pull on that object. An objects weight and mass may not be the same. An example that is often used, is comparing the mass and weight of an astronaut on the Earth and on the moon. An astronaut on the moon will have the same mass as she/he has on the Earth. However, the astronaut will weigh only 1/6th as much on the moon as they do on the Earth. The reason this occurs is because the moon's gravitational pull is 1/6th that of the Earth.

PROCEDURE:

1. Students will use film canisters, sand, brass mass sets and balances to make their own mass sets.
2. Give each student a **Student Activity Sheet 1-3, Making Mass Sets.**
3. Students should work in groups of 3, each making their own mass sets.
4. Each group should obtain a balance and brass mass sets.
5. Each student should obtain: 6 film canisters with lids, 6 adhesive labels, one laboratory scoop, cup of sand.
6. Demonstrate how to make each mass equivalent by doing the 10 gram mass together. To show the relationship (1 cm^3 = 1 ml = 1 gram) have students complete the 10 gram mass with their water scoops from Activity 1-2, Part A.
7. Have students follow directions on **Student Activity Sheet 1-3** to complete the rest of the activity.

*To insure accuracy, balance trays should be clean.

TEACHER DEMO: **WATER DISPLACEMENT**

OBJECTIVE(s): After completing this demo, students will be able to:

- ▷ be introduced to the process of water displacement.

MATERIALS:	
6-250ml plastic beakers	6-50ml graduated cylinders
clay-5 different sized pieces	

PROCEDURE:

1. In this activity, the students will use different sized pieces of clay to displace varying amounts of water.
2. Place students into 6 equal groups with one instructor.
3. The students will take turns using graduated cylinders and beakers to observe water displacement in action. (The container used will depend on the size of the piece of clay.)
4. Depending on the ability of your group, you may want to bring up how to find the volume of irregular shaped objects again (see Background Information on Activity 2-1). The volume of irregular shaped objects is found using the water displacement method.

*Estimation game. Challenge students to guess the length of a piece of string in centimeters. (Winners will be announced at the beginning of lunch.)

ACTIVITY 2-1: MAKING A WATER SCOOP & GRADUATED CYLINDER

OBJECTIVE(s): After completing the activity, students will be able to:

- ▷ understand that a cube with sides of 1 centimeter (cm) lengths will hold 1 cubic centimeter (cm^3) of water.
- ▷ calibrate a measuring device in cubic centimeters (cm^3).
- ▷ understand that one cubic centimeter (cm^3) of volume is the same as one milliliter (ml) of volume.
- ▷ understand the meaning of the term volume.

MATERIALS:

30 Student Activity Sheet 2-1, Making a Water Scoop & Graduated Cylinder	
30 Water Scoop Patterns	
6 plastic pitchers	1 roll paper towels
15 rolls of **Scotch** tape	30 scissors
30 medium paper clips	30 vials
30 adhesive labels	30 - 9oz plastic cups

BACKGROUND INFORMATION:

Volume is the amount of space an object takes up. The liter (L) is the basic unit of liquid volume in the metric system. A liter is slightly more than a quart. For liquid volume smaller than a liter, the milliliter (ml) is used. There are 1000 milliliter in one liter. A 12 ounce can of pop holds approximately 350 milliliters of liquid. The graduated cylinder is an instrument used to measure liquid volume.

The metric unit used to measure the volume of solids is the cubic centimeter (cm^3 or cc). The volume of a regular shaped object can be calculated by multiplying its length, width, and height (L x W x H). Cubic centimeters are often used in measuring the volume of liquids as well as solids. For example, when a nurse administers an injection he/she measures the amount of medicine in cubic centimeters (cc).

To find the volume of an irregular shaped object the method most commonly used is called water displacement. This is done by submerging the irregular shaped object into a graduated cylinder filled with a known amount of water. By observing the rise in water level (ml), you can determine the volume of the irregular shaped object.

PROCEDURE:

1. In the following two activities, the students will learn about liquid volume by making their own graduated cylinder. Introduce cubic centimeter (cm^3 or cc) to the students. Refer to the metric cubes that students made in Activity 1-1A.
2. Give each student a **Student Activity Sheet 2-1** and a **Water Scoop Pattern** (use the Cubic Centimeter pattern for Water Scoop pattern).
3. Students need to use Scotch Magic Tape for this activity. Before cutting, tape is put on both sides of the pattern to make it semi-water proof.
4. Students should follow directions provided on Student Activity Sheet 2-1, Part A, to complete this activity.
5. Have students start on Part B of **Student Activity Sheet 2-1, Making a Graduated Cylinder.**
6. Have each student run a piece of correction tape lengthwise on the vial. Then have them scoop three cubic centimeters of water into the vial. Have students make a mark at the water line. (Stop and explain to the students that they should use the bottom of the water line as the place to mark. You may want to bring up the term "meniscus" at this point. Also be sure to emphasize that students read at eye level.) **One cubic centimeter equals One milliliter.**
7. Students should add three more cubic centimeters of water and make another mark. Have students proceed to make marks and develop a scale as they add cubic centimeters of water. It is useful to have the students make a heavier line at 9, so they have a reference point.
8. Students should follow directions provided to complete this activity.
9. After the students have completed calibrating their graduated cylinders, have students cover their numbers (calibrations) with a piece of scotch tape. This will stop the ink from coming off when the students are using their graduated cylinders.
10. It is also a good idea to give the students an estimation of the amount of scoops it will take to fill their vial, i.e. 10-12 scoops.

ACTIVITY 2-2: **METRIC RAINBOW**

OBJECTIVE(s): After completing the activity, students will be able to:

- ▷ identify the graduated cylinder as an instrument that measures liquid volume.
- ▷ use a graduated cylinder to measure liquid volume using proper metric units (ml).
- ▷ practice following directions.
- ▷ identify color changes caused by mixing different solutions.

MATERIALS:

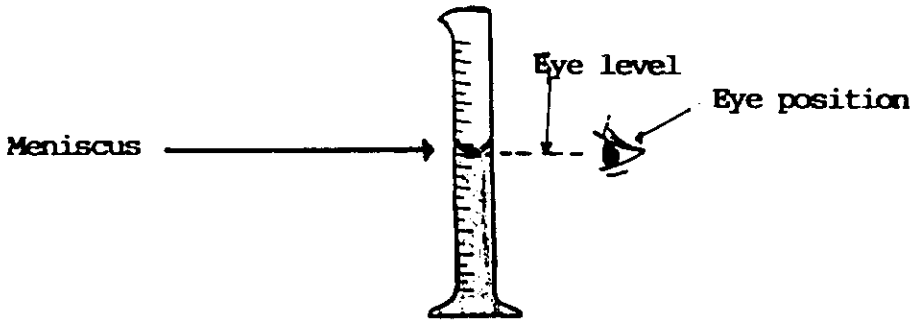
1 box food coloring (McCormick's)	15 medicine droppers
25-250ml plastic beakers	15 visa vis markers
3 plastic pitchers	90-25ml test tubes
15 test tube supports	crayons
15-50ml graduated cylinders	Student Activity Sheet 2-2
Student graduated cylinders from Activity 2-1	

BACKGROUND INFORMATION:

The liter (L) is the basic unit of measurement for liquid volume in the metric system. It is a little larger than the English system, quart. The milliliter (ml) is used to measure volumes that are less than one liter. There are 1000 milliliter in one liter.

The graduated cylinder is an instrument used to measure liquid volume. It is a cylindrical tube calibrated in milliliters. There are three basic rules that must be followed in order to ensure accurate measurement when using a graduated cylinder:

1. Make sure the graduated cylinder in on a flat, horizontal surface,
2. Read the calibrations at eye level,
3. Read the volume at the bottom of the **meniscus**. The meniscus is the dip that forms in the graduated cylinder due to the adhesive characteristic of water (surface tension).



PROCEDURE:

*Prepare colored water in plastic pitchers before activity. Colors needed are red, blue, and yellow. It is important to use the same amount of food coloring (drops) in each solution.

1. In this activity students will measure colored liquids with graduated cylinders using proper metric units (ml).

2. Have students work in groups of 2. Each group will need the following materials:

6 test tubes
1 test tube support
1-50ml graduated cylinder
student graduated cylinder from Activity 2-1
crayons
1 visa vis marker (any color)

3. Pour 50 ml of each colored solution into 250 ml plastic beakers. Two groups will share the 3 beakers of different colored solutions.
4. When using the graduated cylinders, remind students to rinse cylinders between solutions.
5. Have students following the directions on Student Activity Sheet 2-2 to finish the activity. The purple colored mixture will vary with each student.
6. You may want to help students with step 8 and 9 on the Student Activity Sheet 2-2.
7. The brand of food coloring you use will make a difference. We found that the concentration of red food coloring varies from brand to brand.
8. Challenge the students to combine the colors to make other colors, i.e. turquoise, chartreuse, etc.

ACTIVITY 2-6: **HYDROMANIA METRIC OLYMPICS**

OBJECTIVE(s): After completing the activity, students will be able to:

- ▷ estimate using the metric units.
- ▷ measure length, liquid volume and mass using appropriate metric units and instruments.

MATERIALS:	
3 aluminum pie pans	30 clear plastic straws
2 bags pinto beans	10 meter sticks
1 - 25 meter tape measure	30 cotton balls
3 large sponges	2 plastic buckets
2 plastic pitchers	35 sheets centimeter graph paper
2 balances w/ mass sets	7 clip boards
30 **Student Recording Sheets**	Station Posters (7)
4 rolls of masking tape (1")	20 craft sticks (for markers)
Lifesavers candy (prizes)	Awards-1st, 2nd, 3rd, & 4th place

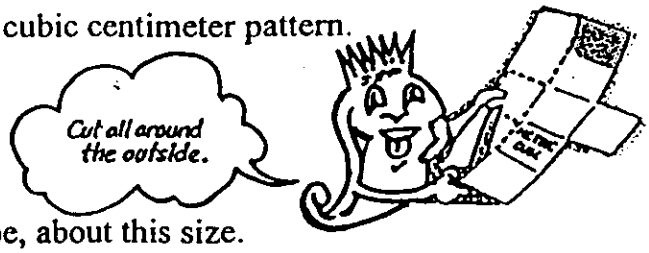
PROCEDURE:

1. Students will work in teams. Depending on time, you may want teams to choose 5 out of 7 events. If time permits have the teams experience all 7 events.
2. Hand out **Student Recording Sheet** and explain procedures. *(Student should put name and team number on sheet.)
3. To begin, line up students and have them count off (1-7) to determine their starting point and team number. Teams should rotate to each station.
4. Each station should have a poster describing the event. Materials for each station are listed on the back of the poster.
5. Students should make an estimate prior to each event and record it in the estimation column on the Student Recording Sheet. After the estimate is recorded, students will give their recording sheet to the official at their station.
6. Officials should record the actual result for each student and initial it.
*7. Scoring will be determined by how close each student is to their estimate. This is done by taking the difference between the actual and estimated result. The winner of each event is the team with the combined smallest difference.
8. There will be an Awards Ceremony at the conclusion of the Olympics to honor winners of the events. *Medals: 1st (blue ribbon), 2nd (red ribbon), 3rd (white ribbon), 4th (green ribbon), Grand Champion (purple ribbon).

Student Activity Sheet 1-1 A

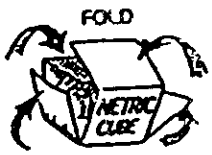
METRIC CUBE

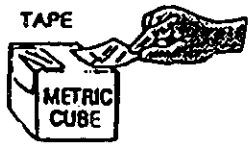
1. Carefully cut out the cubic centimeter pattern.



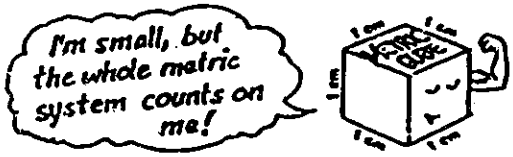
2. Cut two pieces of tape, about this size.

3. Fold along the lines, then tape into a cube.





4. Every edge on this metric cube measures 1 centimeter.



5. Use your cube to measure the length of each line. Write your answers in the space provided to the right of each line. Your answer should be written to the nearest whole centimeter.

a. _____	a. _____cm
b. _____	b. _____cm
c. _____	c. _____cm

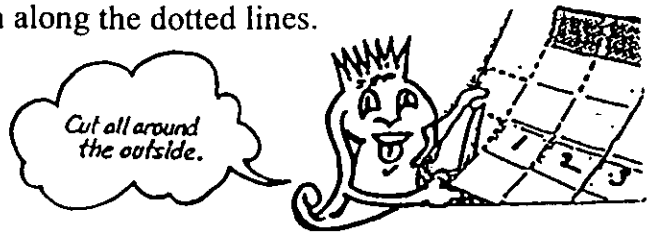
6. Use your centimeter cube to measure the lengths of these familiar objects:

a. your pencil	a. _____cm
b. your partner's little finger	b. _____cm
c. the width of your paper	c. _____cm

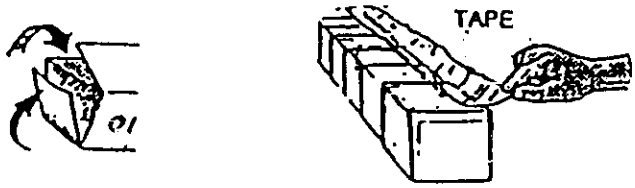
Student Activity Sheet 1-1 B

CENTIMETER RULER

1. Carefully cut out the pattern along the dotted lines.



2. Fold along the solid lines and tape along open edge.



3. Your metric ruler should look as follows when completed.

4. Use your metric ruler to measure the lengths of the following lines. Write your answers in the space provided to the right of each line. Your answer should be written to the nearest <u>whole</u> centimeter.

a. _____	a. _____ cm.
b. _____	b. _____ cm.
c. _____	c. _____ cm.

5. Use your metric ruler to measure the lengths of these familiar objects:

a. your shoe	a. _____ cm.
b. your partner's nose	b. _____ cm.
c. the distance from your elbow to your wrist	c. _____ cm.

Student Activity Sheet 1-1 C

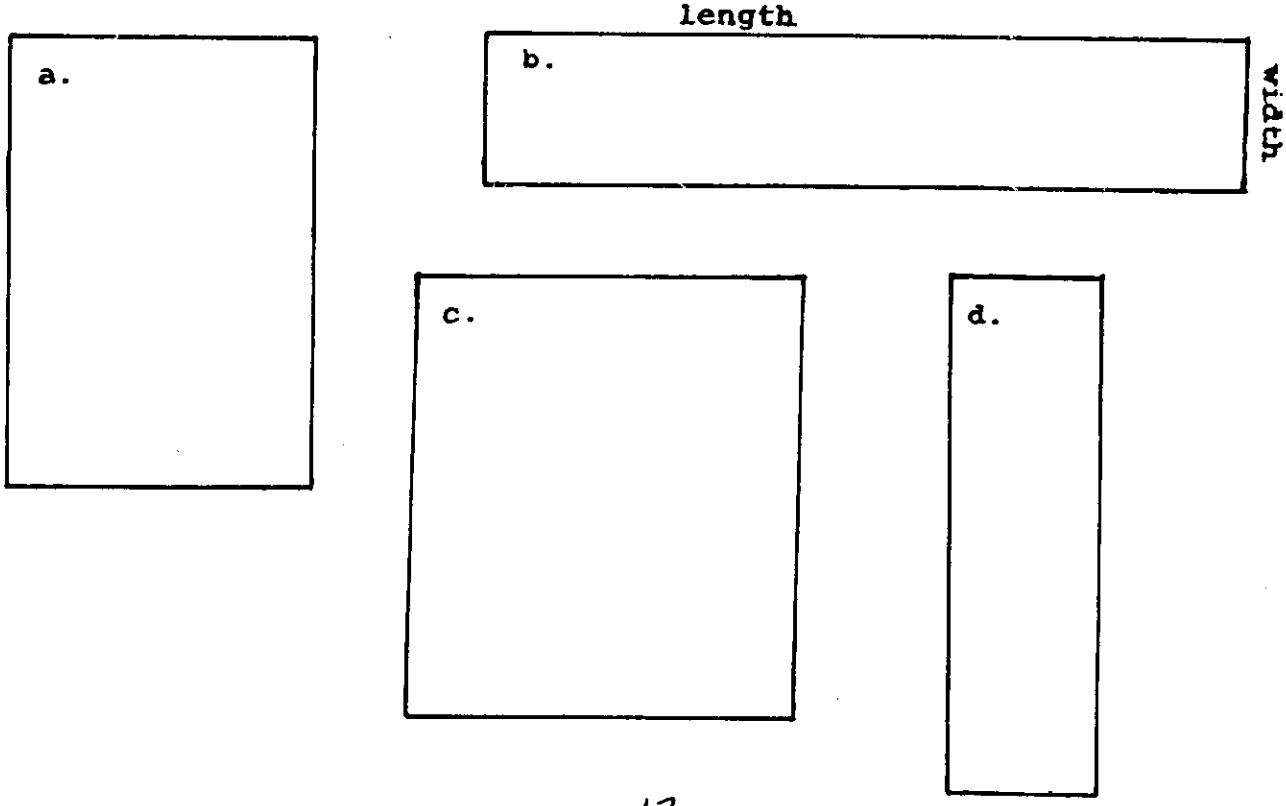
SQUARE CENTIMETERS

1 cm x 1 cm = 1 sq. cm.

1. Using your metric ruler, measure the length (longer side) and width (shorter side) of each box below. Then determine the area of each rectangle below. Remember, **area** refers to the number of square centimeters that can fit in each rectangle.

Box	Length (cm.)	Width (cm.)	Area (square cm.)
a.			
b.			
c.			
d.			

2. One way to find the area of a rectangle is to count how many square centimeters fit into that rectangle. What is another way to find the area of a rectangle? Explain why this method works.



Student Activity Sheet 1-3

MAKING MASS SETS

1. Get with 2 other friends and obtain a balance and a brass mass set.

2. Each of you need:
   - 6 film canisters with lids
   - 6 adhesive labels
   - cup of sand
   - 10 paper clips
   - 1 laboratory scoop
   - labeling pen
   - 1 large rubber band

3. Label your canisters with labels that read as follows:
   (Note: the abbreviation "g" refers to *gram*, the basic unit of weight in the metric system)

   10 g
   20 g
   30 g
   40 g
   50 g

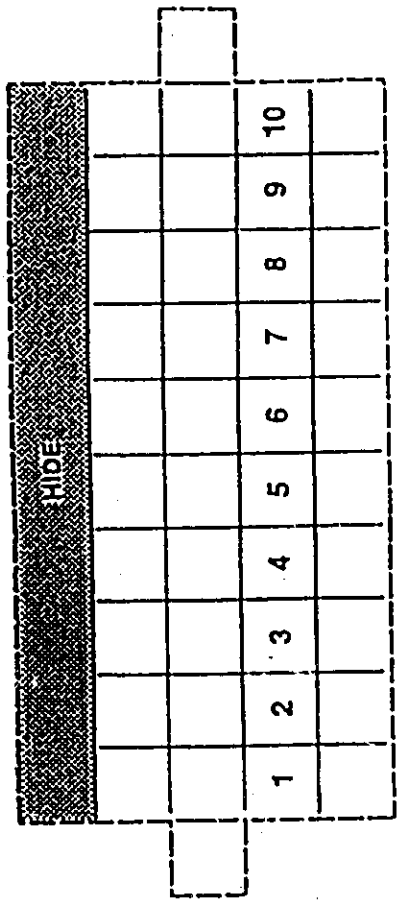
4. Observe as your instructor demonstrates how to make a 10 gram mass. Place a 10 gram brass mass on one side of the balance. Take the lid off the 10 gram canister and place both the lid and canister on the other side of the balance. Carefully add sand to the canister using your laboratory scoop until the balance trays are even (be careful not to spill sand in tray). Replace lid tightly when you are done and place to the side.

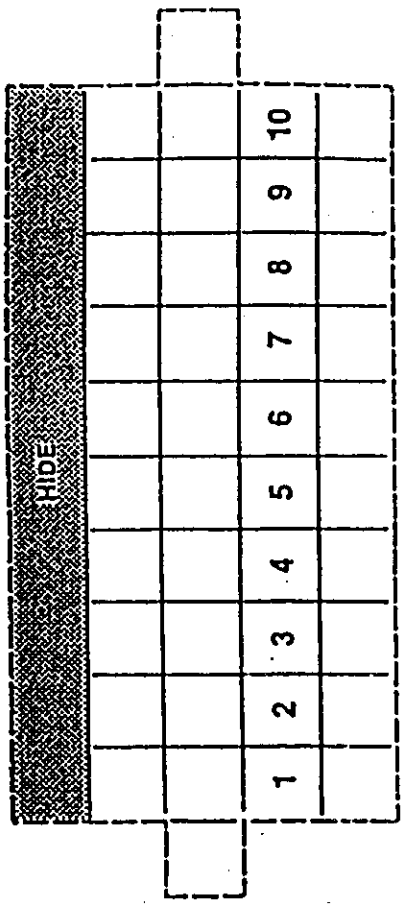
5. Repeat step 4 using the 20 g , 30 g, 40 g, and 50 g canisters.

6. Add 10 paper clips to the canister labeled gram. This gram canister contains 10-one gram paper clips. These paper clips will be used to mass objects that fall between the gram masses that you have. For example, an object that masses out to 13 grams in one tray would be balance by the 10 gram mass and 3 paper clips.

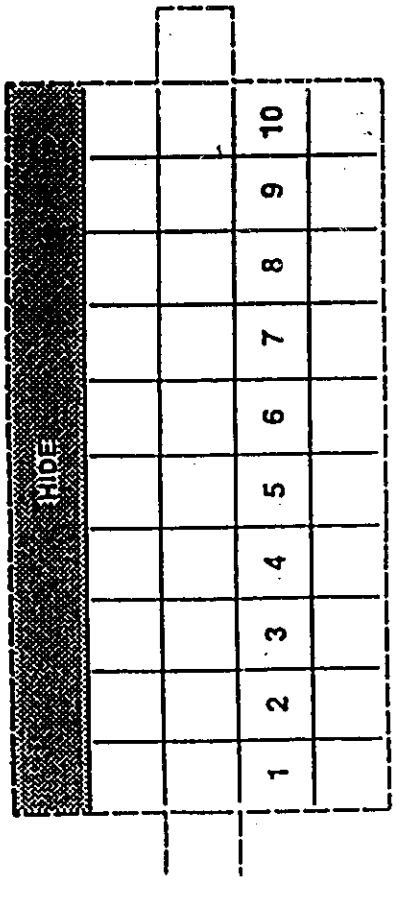
7. When you are finished making all your mass canisters, bind them together using a large rubber band.

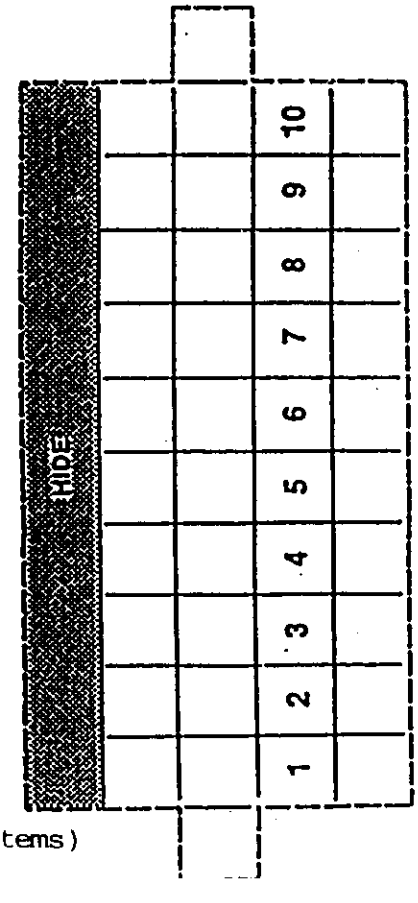
8. Your instructor will have a variety of items that you can weigh using your balance and your mass sets.





CENTIMETER RULER PATTERNS





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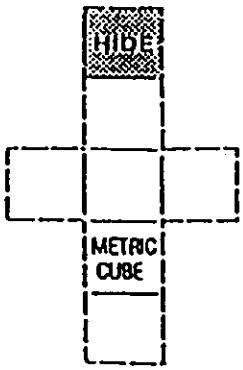
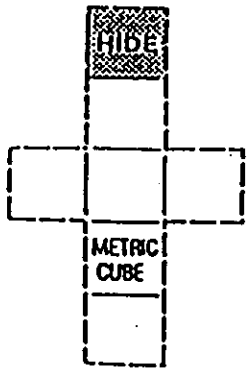
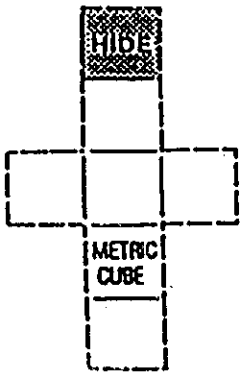
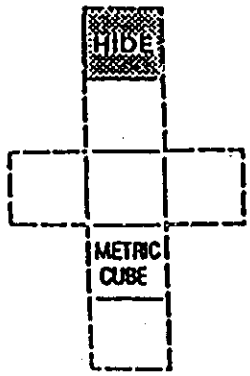
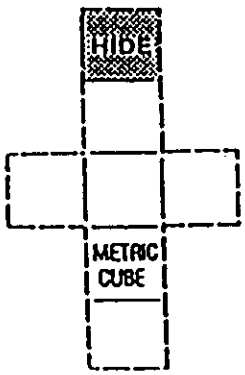


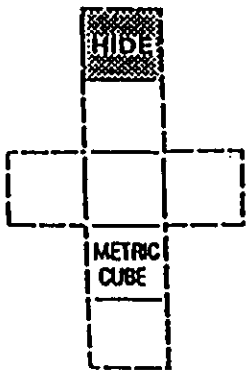


CUBIC CENTIMETER PATTERNS









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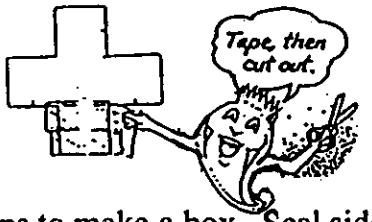
Student Activity Sheet 2-1

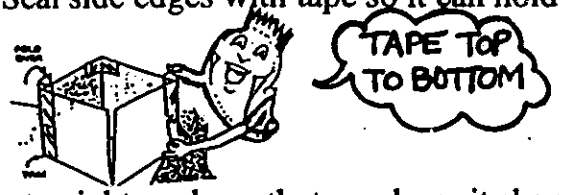
MAKING A WATER SCOOP

Activity 2-1, Part A

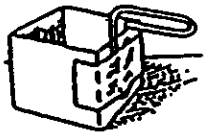
1. Cover both sides of the pattern with Scotch Magic tape. Cut out the Water Scoop Pattern.



2. Fold up all four flaps to make a box. Seal side edges with tape so it can hold water.



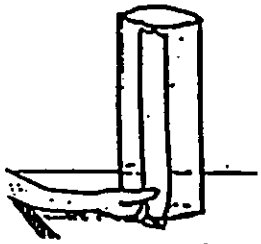
3. Obtain a medium paper clip and bend at a right angle so that you have it shaped like the letter L. Then tape to side of box as shown.



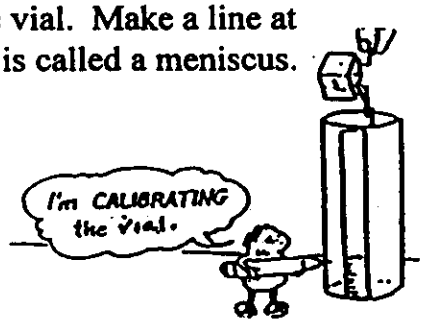
Activity 2-1, Part B

MAKING A GRADUATED CYLINDER

1. Obtain a vial and a piece of adhesive tape. Run the label lengthwise on the vial as shown below.



2. Using your water scoop, add **three scoops** of water to the vial. Make a line at the bottom of the dip that has formed in your vial. This dip is called a meniscus. **Repeat** this procedure till you vial is **full** of water.

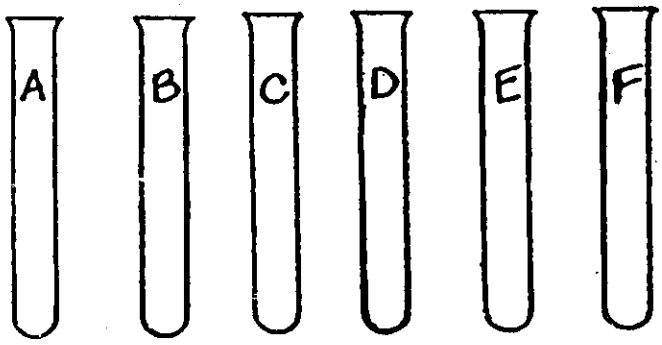


3. The volume of your vial is _____cubic centimeters.

Student Activity Sheet 2-2

METRIC RAINBOW

1. Label each test tube A, B, C, D, E, and F with marker and place in test tube support.



2. Obtain a beaker of each of the colored solutions (red, yellow, and blue).

Using the 50 ml graduated cylinder, complete steps 3 thru 5. (Be sure to rinse the graduated cylinder between each solution.)

3. Measure out 19 ml of red solution and pour into test tube A.

4. Measure out 18 ml of yellow solution and pour into test tube C.

5. Measure out 18 ml of blue solution and pour into test tube E.

Now, using your own graduated cylinder, complete steps 6 thru 9. (Again be sure to rinse your graduated cylinder between each solution.)

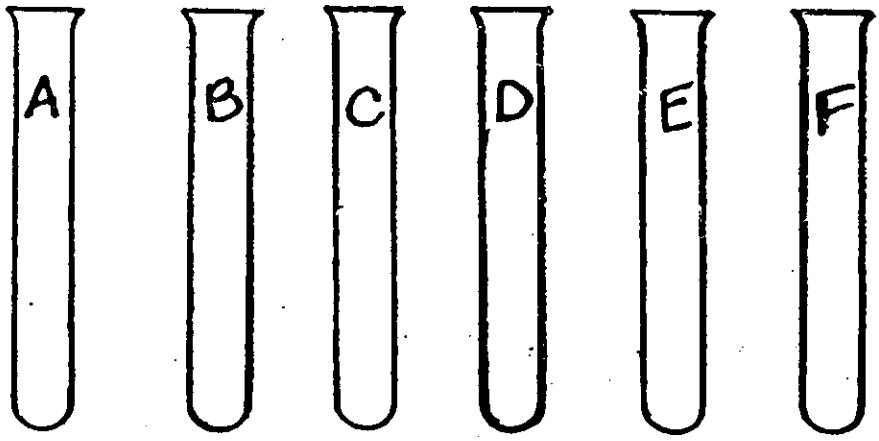
6. Measure out 4 ml from **test tube C** and pour into **test tube D.**

7. Measure out 7 ml from **test tube E** and add it to **test tube D.** Mix.

8. Measure out 4 ml from **blue beaker** and pour into test tube F. Then measure out 7 ml from **red beaker** and add to test tube F. Mix.

9. Measure out 8 ml of solution from **test tube A** and pour into **test tube B.** Then measure out 3 ml of solution from **test tube C** and add to **test tube B.** Mix.

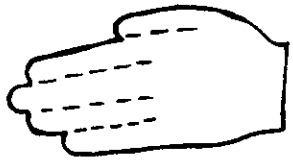
10. Use your crayons to show your results. Color in the test tubes shown below with the appropriate color.



Student Activity Sheet 2-6

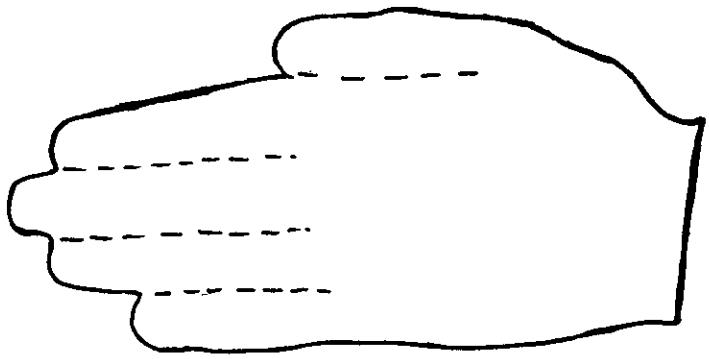
HYDROMANIA METRIC OLYMPICS

NAME_____

EVENT	ESTIMATE	ACTUAL	SCORE (difference)
1. PIE PAN DISCUS 	cm	cm	cm
2. STRAW JAVELIN 	cm	cm	cm
3. COTTON THROW 	cm	cm	cm
4. PINTO BEAN GRAB 	g	g	g
5. SPONGE SQUEEZE 	ml	ml	ml
6. BIG HAND CONTEST 	cm^2	cm^2	cm^2
7. BUNNY HOP 	cm	cm	cm

TOTAL SCORE _____

BIG HAND CONTEST



1. **ESTIMATE** in square centimeters the area of your hand print. Put estimate on your recording sheet.

2. Place one hand on a sheet of centimeter graph paper and trace the outline of your hand. Figure the area by counting the squares inside your hand print.

3. Cut out your hand print, sign your name and area in cm^2, and post on wall.

SPONGE SQUEEZE

1. Have large sponge soaking in bucket of water.

2. **ESTIMATE** the amount of water (in ml) that you think you can get out of the sponge with **one squeeze**. Put estimate on your recording sheet.

3. Squeeze the sponge into separate container. Use graduated cylinders to measure results in milliliters.

PINTO BEAN GRAB

1. **ESTIMATE** (in grams) the amount of pinto beans you can grab in **one** hand. Put your estimate on your recording sheet.

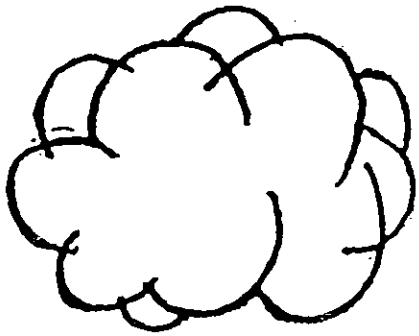
2. With **one** hand grab a fistful of pinto beans from the container. Mass on a balance and record results on your recording sheet.

PIE PAN DISCUS

1. **<u>ESTIMATE THE DISTANCE</u>**
   (in cm) you think you can throw the pie pan discus. Put your estimate on your recording sheet.

2. Place your toes behind the starting point. Throw the discus and measure the distance from the starting point to where the discus landed.
   <u>One throw per student.</u>

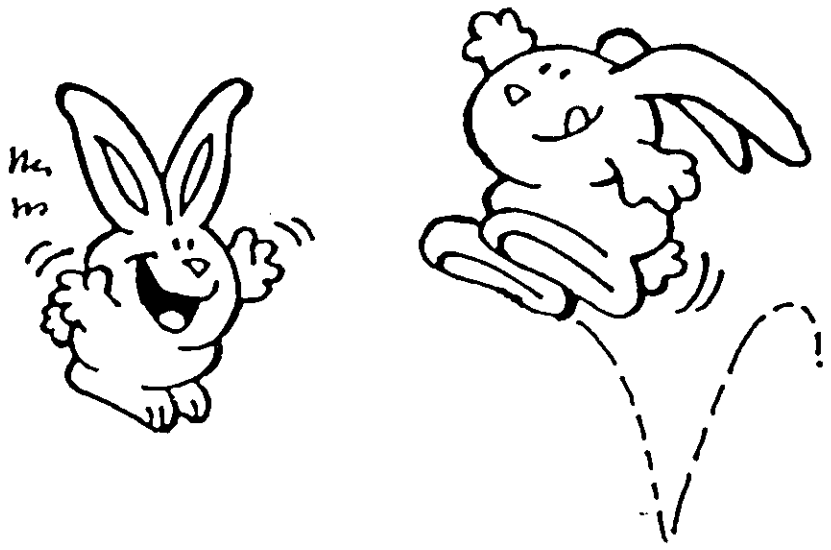
COTTON THROW



1. **ESTIMATE THE DISTANCE** (in cm) you think you can throw the cotton ball. Put your estimate on your recording sheet.

2. Place your toes behind the starting point. Throw the cotton ball and measure the distance from the starting point to where the cotton ball landed.
   One throw per student.

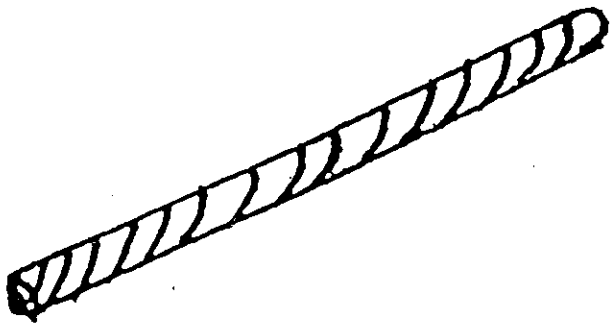
BUNNY HOP



1. **<u>ESTIMATE THE DISTANCE</u>**
   (in cm) you think you can do the bunny hop. Put your estimate on your recording sheet.

2. Place your toes behind the starting point. Take one hop and measure the distance from the starting point to where your back heel landed.
   <u>One hop per student.</u>

STRAW JAVELIN



1. **<u>ESTIMATE THE DISTANCE</u>**
   (in cm) you think you can throw the plastic straw javelin. Put your estimate on your recording sheet.

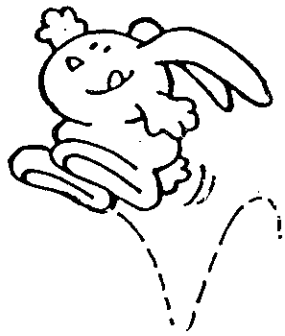
2. Place your toes behind the starting point. Throw the javelin and measure the distance from the starting point to where the javelin landed.
   <u>One throw per student.</u>

PIE PAN

DISCUS

HYDROMANIA METRIC OLYMPICS

BUNNY HOP



HYDROMANIA METRIC OLYMPICS

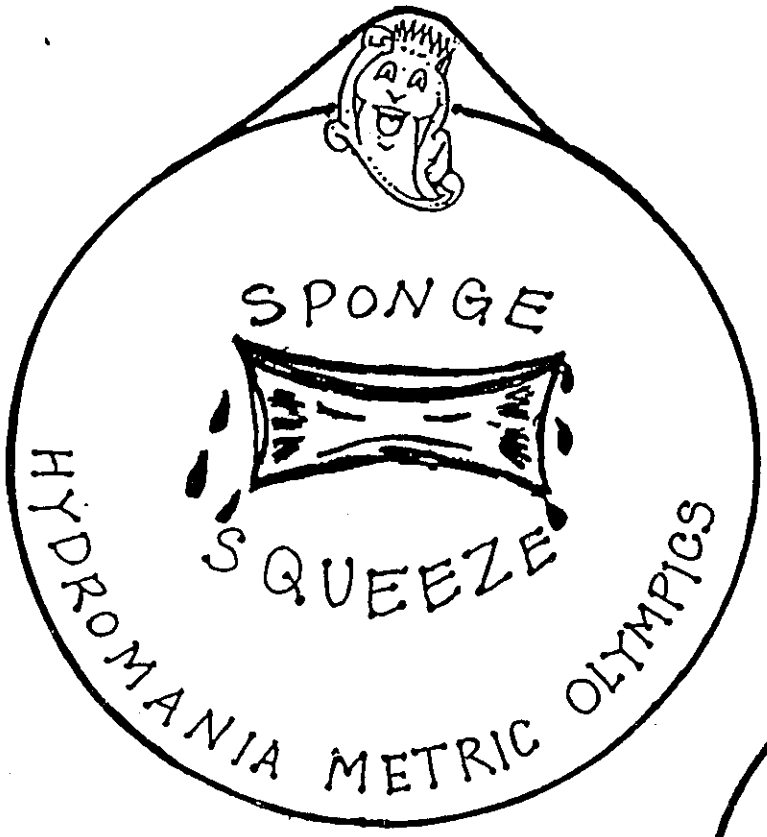
COTTON THROW

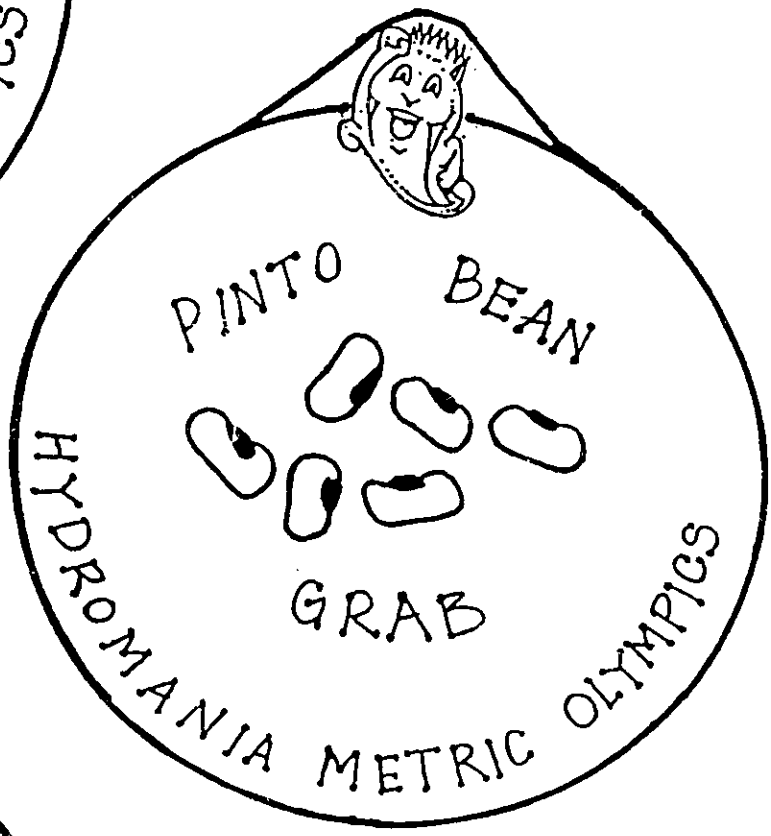
HYDROMANIA METRIC OLYMPICS

STRAW

JAVELIN

HYDROMANIA METRIC OLYMPICS


SPONGE
SQUEEZE
HYDROMANIA METRIC OLYMPICS


PINTO BEAN
GRAB
HYDROMANIA METRIC OLYMPICS


BIG HAND
CONTEST
HYDROMANIA METRIC OLYMPICS

DAY 2 **TEACHER NOTES**

Estimation Game: Estimate the number of adult chinook salmon that will grow into mature adults from 5,000 eggs. (Answer-Eight salmon eggs will mature to adults. These salmon will be represented by eight red beads in the jar of pinto beans.) From these eight adult salmon, estimate the number that will make it back to their river to spawn. (Answer-Four adult salmon will return to their river to spawn. These salmon will be represented by red beads with black dots in the jar of pinto beans. The winners will be announced during the break.)

Story Time: Journey of the *Oncorhynchus*-Chapter Two. Each student will need their Journey of the *Oncorhynchus* story book. Before starting the story, set up either the Journey of the *Oncorhynchus* mural by adding **section two** or referring to section two of the poster. Call attention to the mural/poster by having the students search for the hidden salmon in section two. The first student to find the hidden salmon will be awarded a prize.

ACTIVITY 2-1: **CABBAGE CHEMISTRY**

SCIENCE CONCEPTS/PROCESSES: Measure

SKILLS: Thermometer Reading

OBJECTIVE(s): After completing the activity, students will be able to:

- use balances to measure mass in grams.
- use a graduated cylinder to measure liquid volume using proper metric units (mL).

MATERIALS:

10 balances	10-50 gram masses
2 red cabbages-(shredded)	1 gallon tap water
1 hot plate	1-10 quart sauce pan (**non-aluminum**)
35-250 mL plastic beakers	18-50 mL graduated cylinders
hand grater	6 plastic pitchers (1 liter)
1 wooden spoon	1 plastic colander
18-9 oz plastic cups	18 thermometers

BACKGROUND INFORMATION:

The Metric System

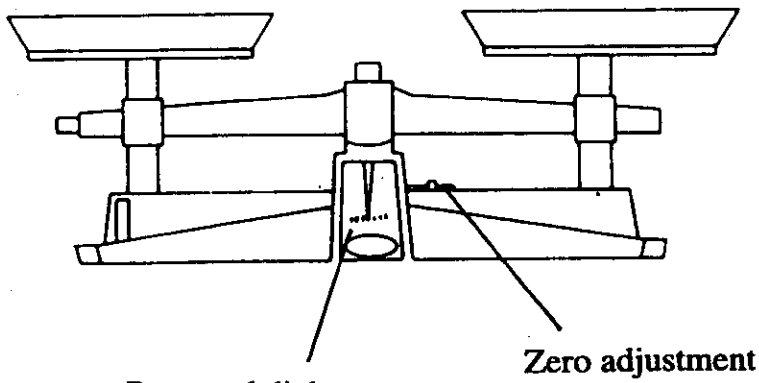
The metric system is a standard system of measurement used worldwide by the scientific community. The United States is one of three countries that still use the English system of measurement for everyday uses, although the U. S. is in the process of converting over to metric. The other two countries using the English system are Liberia and Myanmar (Burma).

The metric system came into existence after the French Revolution. The new government decided to produce a rational set of units for all measurements, the everyday, as well as those used in science and technology. The metric system is a decimal system based on the number ten. This system is used to measure length, volume, mass, and temperature. The base unit of length is the meter (m), derived from the Greek word *metron*, meaning "to measure." A meter is one ten-millionth of the distance between the equator and the North Pole. The volume of an object is measured in liters (L) and cubic centimeters (cm^3 or cc). Metric mass is measured by the units (g) or kilograms (Kg). One kilogram equals 1,000 grams.

Mass - Using the Balance

Before massing an object on the balance, the balance indicator should line up with the center graduation on the recessed dial. If adjustment is necessary, rotate the zero adjustment wheel located to the right of the dial. After obtaining a zero balance, place the object to be weighed on the red (left-hand) pan. Place brass masses on the yellow (right-hand) pan until the pointer again lines up with the center graduation on the recessed dial. The mass of the object is equal to the sum of the weights needed on the right-hand pan to center the pointer.

The kilogram (Kg) is the basic metric unit used to measure mass. Some equal arm balances will use the gram (g or 1/1000 Kg) as its metric unit of measurement.

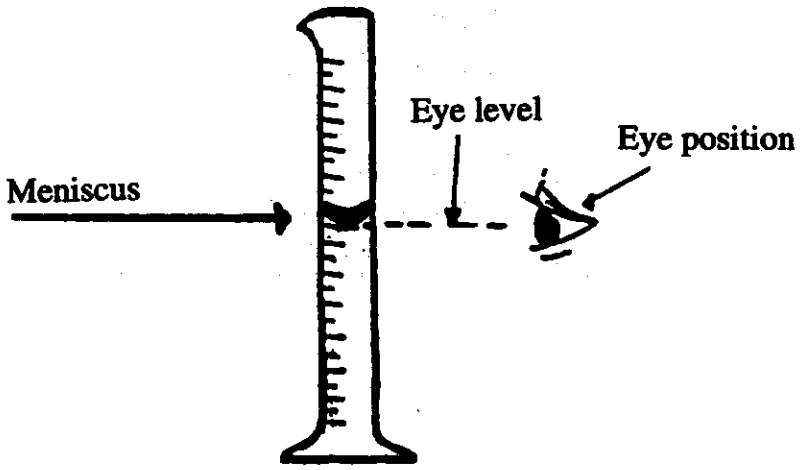


Volume - Graduated Cylinder

The graduated cylinder is an instrument used to measure liquid volume. It is a cylindrical tube calibrated in milliliters. There are three basic rules that must be followed in order to ensure accurate measurement when using a graduated cylinder:

1. Make sure the graduated cylinder in on a flat, horizontal surface,
2. Read the calibrations at eye level,
3. Read the volume at the bottom of the meniscus. The meniscus is the dip that forms in the graduated cylinder due to the adhesive characteristic of water (surface tension).

The liter (L) is the basic unit of measurement for liquid volume in the metric system. It is a little larger than the English system, quart. The milliliter (mL) is used to measure volumes that are less than one liter. There are 1000 milliliter in one liter.



PROCEDURE:

1. In this activity, students will prepare red cabbage indicator solution for Activity 2-3. Using balances and graduated cylinders, students will practice their measurement skills using the metric units (grams and milliliters).
2. Each student should use the balance to mass out 50 grams of shredded red cabbage. Place the 50 grams of cabbage in a 250 mL beaker.
3. Each student should use the graduated cylinder to measure 100 milliliters of tap water. Pour the water over cabbage in the beaker. Instructors should monitor the accuracy of the measurements.

4. Each student should pour their cabbage/water mixture into the large pan for boiling.
5. Instructors will boil the cabbage/water mixture for 10 minutes. Allow the mixture to cool before straining. All the pieces of cabbage should be removed before using this liquid as an indicator solution.
6. After the solution has cooled for about 15 minutes, students should record the temperature of the heated cabbage solution. Instructors should make sure that the students know how to obtain accurate thermometer readings in degrees Celsius. This step should be done after the following teacher demo-Where's the Oxygen?