LAB SAFETY

AND

TECHNIQUES

Safety in the Chemistry Laboratory

Everyone who works in a chemistry laboratory should follow these safety precautions.

1. Wear safety goggles and a laboratory apron in the laboratory at all times.

2. Shoes must be worn in the laboratory. Avoid wearing overly bulky or loose fitting clothing. Remove any dangling jewelry.

3. Conduct only assigned experiments, and do them only when your teacher is present.

4. Know the locations of safety equipment such as eyewash fountains, fire extinguishers, emergency shower, and fire blanket. Be sure you know how to use the equipment.

5. Do not chew gum, eat, or drink in the laboratory. Never taste any chemicals. Keep your hands away from your face when working with chemicals.

6. Wash your hands with soap and water at the end of each laboratory exercise.

7. Read all of the directions for a laboratory procedure before proceeding with the first part. Reread each instruction before you do it.

8. Notify your teacher immediately if any chemicals, such as concentrated acid or base, are spilled.

9. Report all accidents, no matter how slight, to the teacher immediately.

10. Pin or tie back long hair and roll up loose sleeves when working with flames.

11. Do not leave a lighted burner unattended.

12. Use a hot plate instead of an open flame whenever a flammable liquid is present.

13. Read the label on a reagent bottle carefully *before* using the chemical. After removing the chemical from the bottle, check to make sure that it is the correct chemical for that procedure.

14. To avoid contamination, do not return unused chemicals to a reagent bottle. Similarly, never put a pipet, spatula, or dropper into a reagent bottle. Instead, pour some of the reagent into a small clean beaker and use that as your supply.

15. Do not use chipped or cracked glassware. Discard it according to your teacher's instructions.

16. When diluting an acid, *always* pour the acid slowly into water with stirring to dissipate the heat generated. **CAUTION:** *Never pour water into a concentrated acid.*

17. When heating a liquid in a test tube, turn the mouth of the test tube away from yourself and others.

18. Clean up spills and broken glass immediately. Leave your work area clean at the end of the laboratory period.

Safety Symbols

Take appropriate precautions whenever any of these safety symbols appears next to the instructions in a procedure.

Eye Hazard
- Wear safety goggles.

Corrosive Substance Hazard
- Wear safety goggles and laboratory apron.
- Do not touch chemicals.

Fire Hazard
- Tie back hair and loose clothing.
- Do not use a burner near flammable materials.

Poison Hazard
- Do not chew gum, drink, or eat in the laboratory.
- Keep your hands away from your face.

Inhalation Hazard
- Avoid inhaling this substance.

Thermal Burn Hazard
- Do not touch hot equipment.

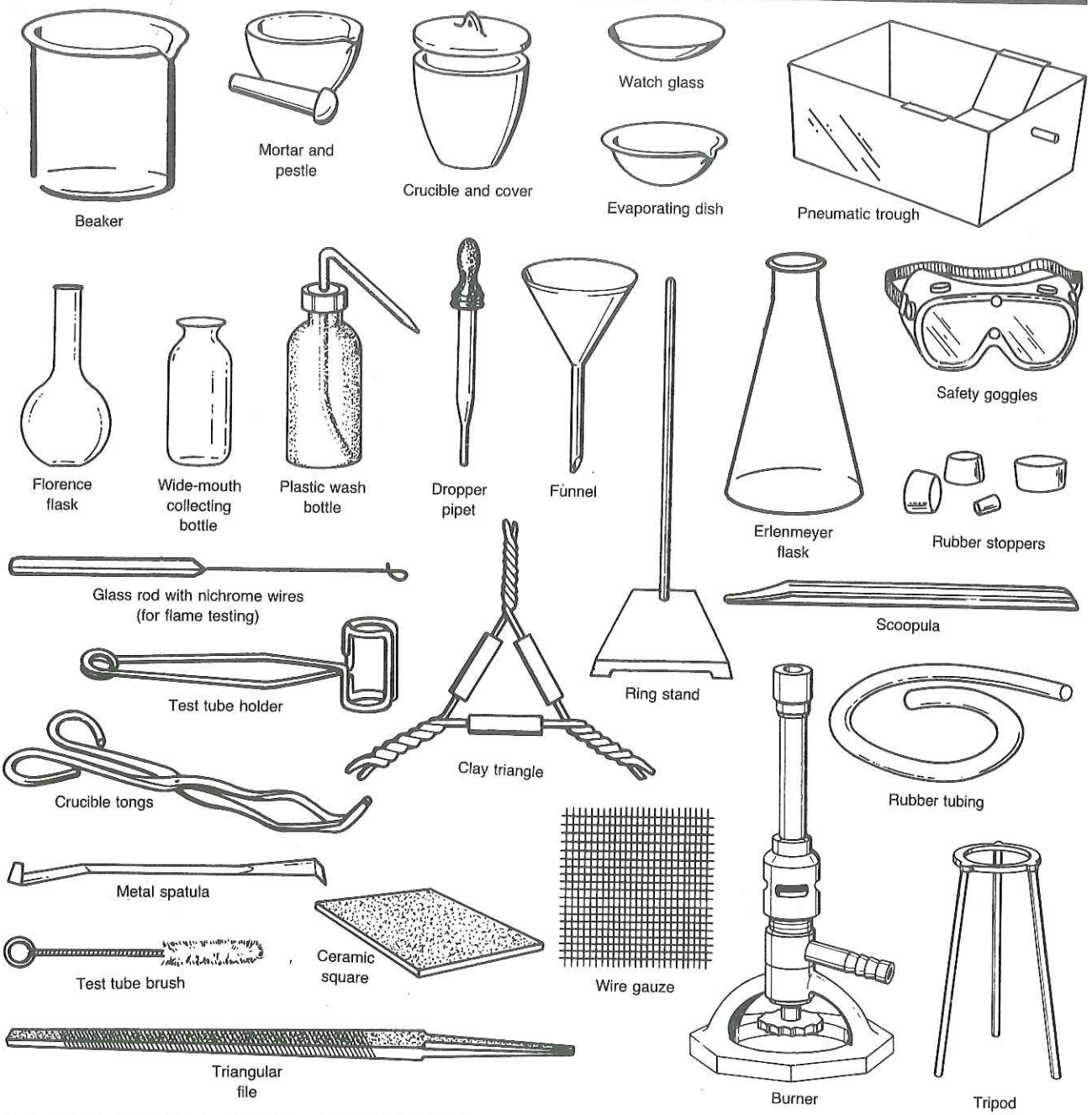
Breakage Hazard
- Do not use chipped or cracked glassware.
- Do not heat the bottom of a test tube.

Disposal Hazard
- Dispose of this chemical only as directed.

Emergency Procedures

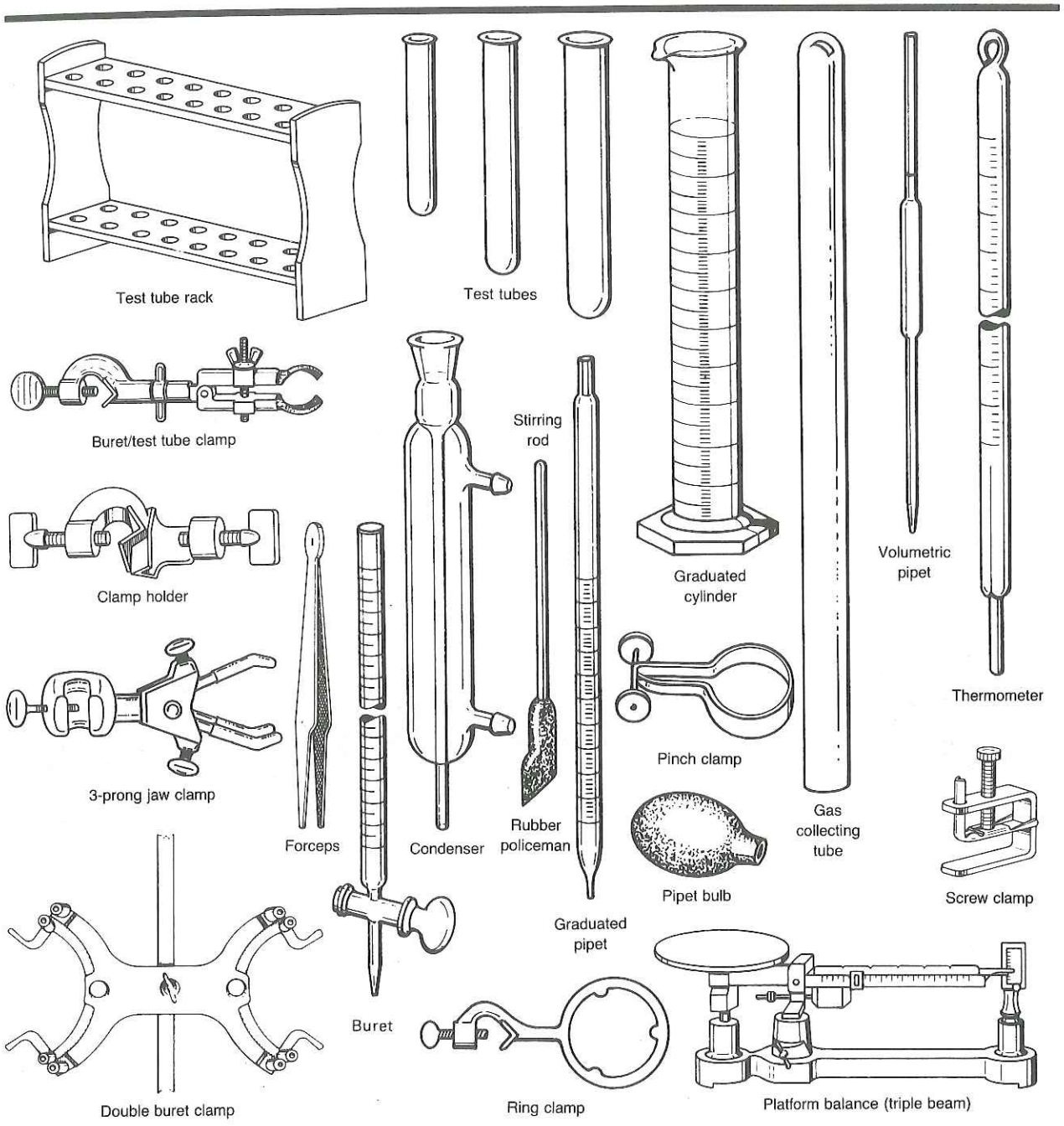
Report any injury, accident, or spill to your teacher immediately. Know the location of the closest eye wash, fountain, fire blanket, fire extinguisher, and shower.

Situation	Safe Response
Burns	Immediately flush with cold water until the burning sensation subsides.
Fainting	Provide fresh air (for instance, open a window). Move the person so that the head is lower than the rest of the body. If breathing stops, use artificial resuscitation.
Fire	Turn off all gas outlets. Unplug all appliances. Use a fire blanket or fire extinguisher to smother the fire. **Caution:** Do not cut off a person's air supply.
Eye Injury	Immediately flush the eye with running water. Remove contact lenses. Do not allow the eye to be rubbed if a foreign object is present in the eye.
Minor Cuts	Allow to bleed briefly. Wash with soap and water.
Poisoning	Note what substance was responsible. Alert teacher immediately.
Spills on skin	Flush with water.



Beaker: glass or plastic; common sizes are 50-mL, 100-mL, 250-mL, 400-mL; glass beakers may be heated. hold solutions.
Buret: glass; common sizes are 25-mL, and 50-mL; used to measure volumes of solutions in titrations.
Ceramic square: used under hot apparatus or glassware.
Clamps: the following types of clamps may be fastened to support apparatus: buret/test-tube clamp, clamp holder, double buret clamp, ring clamp, 3-pronged jaw clamp.
Clay triangle: wire frame with porcelain supports, used to support a crucible.
Condenser: glass; used in distillation procedures.
Crucible and cover: porcelain, used to heat small amounts of solid substances at high temperatures.
Crucible tongs: iron or nickel, used to pick up and hold small items.
Dropper pipet: glass tip with rubber bulb, used to transfer small volumes of liquid.
Erlenmeyer flask: glass, common sizes are 100-mL, 250-mL; may be heated, used in titrations.
Evaporating dish: porcelain, used to contain small volumes of liquid being evaporated.
Florence flask: glass, common sizes are 125-mL, 250-mL, 500-mL, may be heated, used in making and for storing solutions.
Forceps: metal, used to hold or pick up small objects.
Funnel: glass or plastic, common size holds 12.5-cm diameter filter paper. used for filtrations.
Gas burner: constructed of metal; connected to a gas supply with rubber tubing; used to heat chemicals (dry or in solution) in beakers, test tubes, and crucibles.
Gas collecting tube: glass, marked in mL intervals; used to measure gas volumes.
Glass rod with nichrome wire: used in flame tests.
Graduated cylinder: glass or plastic, common sizes are 10-mL, 50-mL, 100-mL, used to measure approximate volumes; must not be heated.
Graduated pipet: glass, common sizes are 10-mL, 25-mL; used to measure solution volumes; less accurate than a volumetric pipet.

goggles: eye protection.



Mortar and pestle: porcelain, may be used to grind crystals and lumpy chemicals to a powder.
Pipet bulb: rubber, used in filling a pipet with a solution, a pipet must never be filled by mouth.
Plastic wash bottle: flexible plastic, squeeze sides to dispense water.
Platform balance: also known as a triple beam balance.
Pneumatic trough: galvanized container with shelf, used in experiments where a gas is collected.
Ringstand: metal rod fixed upright in a heavy metal base; has many uses as a support.
Rubber stoppers: several sizes.
Rubber tubing: used to connect apparatus so as to transfer liquids or gases.
Safety goggles: plastic; must be worn at all times while working in the laboratory.
Screw clamp, pinch clamp: metal, used to block off rubber tubbing.
Spatula, scoopula: metal or porcelain; used to transfer solid chemicals; the scoopula has a larger capacity.

Stirring rod and rubber policeman: glass with rubber sleeve: used to stir, assist in pouring liquids, and for removing precipitates from a container.
Test tube brush: bristles with wire handle, used to scrub small diameter glassware.
Test tube holder: spring metal, used to hold test tubes or glass tubing.
Test tube rack: wood or plastic, holds test tubes in a vertical position.
Test tubes: glass, common sizes small (13 mm x 100 mm), medium (20 mm x 150 mm), large (25 mm x 200 mm), may be heated.
Thermometer: mercury in glass, common range $-10°C$ to $110°C$.
Triangular file: metal, used to scratch glass tubing prior to breaking to desired length.
Tripod: iron, used to support containers of chemicals above the flame of a burner.
Volumetric pipet: glass, common sizes are 10-mL, 25-mL, used to measure solution volumes accurately, must not be heated.
Watch glass: glass, used to cover an evaporating dish or beaker.
Wide-mouth bottle: glass, used with pneumatic trough.
Wire gauze: used to spread the heat of a burner flame.

→ used to heat liquids + observe reactions.

SAFE LABORATORY TECHNIQUES

Pouring Liquids

Follow this procedure when pouring liquids.

1. Use the back of your fingers to remove the stopper from a reagent bottle. Hold the stopper between your fingers until the transfer of liquid is complete. Do not place the stopper on your workbench.
2. Grasp the container from which you are pouring with the palm of your hand covering the label.

3a. When you are transferring a liquid to a test tube or measuring cylinder, the container should be held at eye level. Pour the liquid slowly until the correct volume has been transferred.

3b. When you are pouring a liquid from a reagent bottle into a beaker, the reagent should be poured slowly down a glass stirring rod. (See figure 1) When you are transferring a liquid from one beaker to another, you can hold the stirring rod and beaker in one hand.

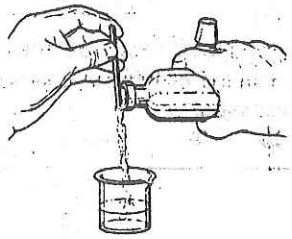


Figure 1. Pouring from a reagent bottle into a beaker.

Using a Gas Burner

Laboratory gas burners produce various kinds of flames when different mixtures of gas and air are burned. The two most common models are the Bunsen burner and the Tirrell burner. Both have adjustable air vents; the Tirrell burner also has a gas control valve at its base. (See figure 2)

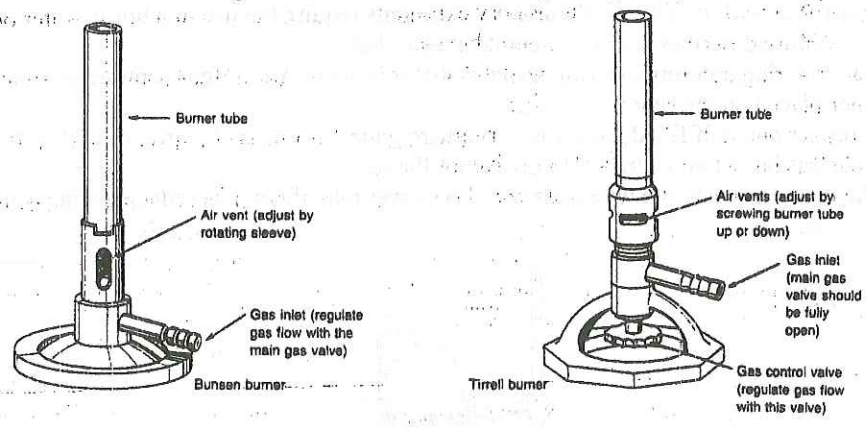


Figure 2. Laboratory gas burners.

1. Examine your laboratory burner. Determine which model you have.
2. Connect the burner to the gas supply with rubber tubing.
3. Close the air vents. If your model is a Tirrell burner also close the gas control valve at the base of the burner.
4. Hold a lighted match at the top of the burner tube and turn on the gas supply. Do this by opening the main gas supply valve located on the top of the nozzle to which you attached the rubber tubing. (If your model is a Tirrell burner, open the gas control valve at the base approximately ½ turn after opening the main gas supply valve.) You should get a yellow or luminous flame. When a Tirrell burner is used, the main gas supply valve should be opened fully and the gas flow regulated by the gas control valve. Gas supply to a Bunsen burner is controlled by the main gas valve.
5. Open the air vents slowly, to admit more air into the flame, to produce a light blue (nonluminous) cone-shaped flame. If the flame "blows out" after lighting, the gas supply should be reduced.

6. Adjust the air vents and gas supply to produce the desired size of flame. For most laboratory work the blue inner cone of the flame should be about one inch high and free of yellow color. If you want a smaller flame, close the air vent slightly and reduce the gas supply. You will learn how to control the burner flame by trial and error.
7. Turn the burner off at the main gas supply valve when done.

Heating Liquids

Heating liquids in a test tube. The correct procedure for heating liquids in the laboratory is important to laboratory safety.

1. Adjust your gas burner to give a gentle blue flame.
2. Fill the test tube one-third full with liquid to be heated.
3. Grasp the test tube with a test tube holder near the upper end of the tube.
4. Hold the test tube in a slanting position in the flame, and gently heat the tube a short distance below the surface of the liquid. (See figure 3)
5. Shake the tube gently as it is being heated, until the liquid boils or reaches the desired temperature.

Never point the open end of a test tube you are heating either toward yourself or anyone working nearby. Never heat the bottom of the test tube.

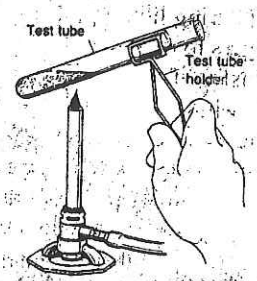


Figure 3. Heating a liquid in a test tube.

Heating liquids in a beaker. Many laboratory experiments require the use of a hot-water or boiling-water bath. This procedure describes how to assemble a water bath.

1. Fasten an iron ring securely to a ring stand so that it is about two to four centimeters above the top of a gas burner placed on the ring stand base.
2. Place a beaker one-half filled with water on a wire gauze resting on the iron ring. (See figure 4)
3. Light your gas burner and adjust it to give a hot flame.
4. Place the burner beneath the wire gauze. For a slower rate of heating, reduce the intensity of the burner flame.

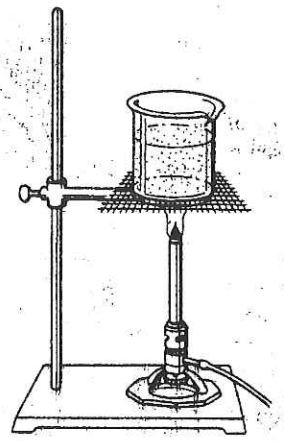


Figure 4. Heating a liquid in a beaker.

Measuring Mass

In many experiments you are required to determine the mass of a chemical used or produced in a reaction. An object's mass is determined by measuring it on a balance. When we determine the mass of an object, we are comparing its mass with a known mass. In the SI the base unit of mass is the kilogram.

*There are many types of laboratory balances. The one we will use is the triple beam balance.
*Check to make sure the balance pan is empty and clean, and all masses should be set on zero. The balance must be level.
*Objects to be weighed directly on the balance pan must be clean, dry, and at room temperature. Solid chemicals and liquids must never be put directly on the balance pan. Liquid samples should be placed in beakers. Solid chemicals may be placed in a beaker, or weighing boat.
**The balance in a precision instrument that must be handled with care.*
*Never move or jar either a balance or the balance table.
*If you spill a chemical on or near the balance, clean it up immediately. If in doubt, ask your teacher.
*Never attempt to weigh an object with a mass greater than the maximum capacity of the balance.
*When you finish weighing, return all the masses to zero, and make sure the balance pan is clean.

1. Move all riders to their zero points. Ensure that the riders rest in the notches on the beams.
2. Check to see that the beam is balanced. The pointer should move the same distance above and below the zero line on the scale or come to rest at the zero line. Use the zero adjustment if necessary. Always zero the balance before you begin any weighing.
3. Place the object whose mass is to be determined on the pan.
4. Slide the riders gently along the beams, one at a time, beginning with the largest. If a beam is notched be sure that the rider is in a notch. The smallest rider does not have notches. When the added masses (the position riders) is equal to the mass of the object on the pan then the pointer will be on the zero line.
5. To record the mass of the object, sum the masses indicated by the positions of the riders on their respective beams.
6. Return all riders to zero and remove your sample. Make sure that the balance pan is left clean.

Measuring Volume

Volume measurements are important in many experimental procedures. Sometimes volume measurements must be accurate; other times they can be approximate. Most volume measures in the laboratory are made using equipment calibrated in milliliters. Although some beakers have graduation marks, these marks are designed only for quick, rough estimates of volume. Accurate volumes must be measured with pipets, burets, or volumetric flasks.

Using a Graduated Cylinder
Half fill a 100 ml graduated cylinder with water, and set the cylinder on your laboratory bench. Examine the surface of the water. Notice how the surface curves upwards where the water contacts the cylinder walls. This curved surface is called a meniscus. (See figure 5)

A volume measurement is always read at the bottom of the meniscus with your eye at the same level as the liquid surface. To make the meniscus more visible you can place your finger or a dark piece of paper behind and just below the meniscus while making your reading.

Graduated cylinders are available in many capacities. The 100 ml cylinder is marked in 1 ml divisions, and volumes can be estimated to the nearest 0.1 ml. The last digit in these measurements is therefore significant but uncertain.

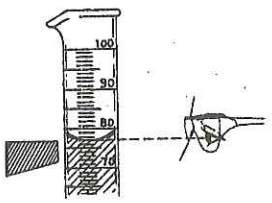


Figure 5. Reading volume in a graduated cylinder.

Laboratory Safety Agreement

MATERIAL	DATE
Review of First Aid in the Laboratory.	_____
Review of Laboratory Techniques	_____
In-class review of laboratory regulations, procedures, safety symbols, and safety equipment	_____

I, _____ , have read and understand the material entitled First Aid in the Laboratory and Laboratory Techniques. I agree to abide by the regulations and procedures outlined in this material. Furthermore, I agree to abide by any additional printed or verbal instructions provided by my teacher or school district during the school year.

_____ _____

student's signature *date*

First Aid in the Laboratory

REPORT ALL ACCIDENTS, INJURIES, AND SPILLS TO YOUR TEACHER IMMEDIATELY.

YOU MUST KNOW: safe laboratory techniques
where and how to report an accident, injury, or spill
location of first-aid equipment, fire alarm, phone, school nurse's office
evacuation procedure

Injury	Safe Response
burns	Flush with water. Call your teacher immediately.
cuts and bruises	Follow the instructions on the first-aid kit. Report to the school nurse.
fainting or collapse	Provide the person with fresh air. Have the person recline so that their head is lower than their body. Call your teacher. A nurse or doctor may be needed to provide artificial respiration.
fire	Wrap the person in fire blanket. Extinguish all flames.
foreign matter in eye	Flush with plenty of water. Use eyewash bottle or fountain.
poisoning	Note the suspected poisoning agent and call your teacher.
severe bleeding	Apply pressure or a compress directly to the wound and get medical attention.
spills on skin	Flush with water or use safety shower.
acid spills	For acid spills, apply baking soda, $NaHCO_3$, and call your teacher.
base spills	For base spills, apply boric acid, H_2BO_3, and call your teacher.