Basic Laboratory Equipment

- Chemistry is the science that deals with the composition and properties of substances and various elementary forms of matter.
- Chemistry, as are all sciences, is a discipline based on observation.
- In lecture, you will learn the principles and theories that, to date, best explain the observations that have accumulated.
- The problem is that, if all you have is lecture, then it is all too easy to forget that these theories apply to the “real world.”
- The laboratory experience is, by design, your opportunity to see these principles and theories in practice.

Beaker

- A beaker is a simple container for stirring, mixing and heating liquids commonly used in many laboratories.
- Beakers are generally cylindrical in shape, with a flat bottom. Most also have a small spout (or "beak") to aid pouring.
- Beakers are available in a wide range of sizes, from 5 milliliter up to 2 liter.
- Beakers are commonly made of glass (usually borosilicate glass, pyrex®), but can also be in metal or certain plastics.
- Borosilicate glass mainly constitute from silica and boron oxide.
- Borosilicate glasses are known for having very low coefficients of thermal expansion making them resistant to thermal shock.

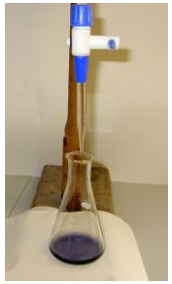
Beaker

- Beakers are often graduated, that is, marked on the side with lines indicating the volume contained.
- These marks are not intended for obtaining a precise measurement of volume, but rather an estimation.
- Do not measure volume or prepare solutions at definite concentrations using a beaker!
- The presence of a lip means that the beaker cannot have a lid.
- However, when in use, beakers may be covered by a watch glass to prevent contamination or loss of the contents, but allowing venting via the spout.
- Alternatively, a beaker may be covered with using a piece of parafilm

Erlenmeyer flask

- An Erlenmeyer flask, also known as a conical flask, is a widely used type of laboratory flask which features a flat bottom, a conical body, and a cylindrical neck.
- It is named after the German chemist Emil Erlenmeyer, who created it in 1860.
- The Erlenmeyer is usually marked on the side (graduated) to indicate the approximate volume of contents.
- Do not measure volume or prepare solutions at definite concentrations using an erlenmeyer flask!
- The opening usually has a slight rounded lip so that the Erlenmeyer can be easily stoppered using a piece of cotton wool, rubber bung or similar.

Erlenmeyer flask



- Erlenmeyer flasks are extremely useful in the lab setting for stirring the contents by hand by swirling the flask.
- Erlenmeyers are used in chemistry labs for titration, as they can be held and the contents mixed single-handed leaving the other hand free to add reagent.
- Titration, also known as titrimetry, volumetry, is a common laboratory method of quantitative chemical analysis that is used to determine the unknown concentration of an identified analyte.
- A reagent, called the titrant is prepared as a standard solution. A known concentration and volume of titrant reacts with a solution of analyte in the presence of indicator to determine concentration.
- Erlenmeyers are also used in microbiology for the preparation of microbial cultures.

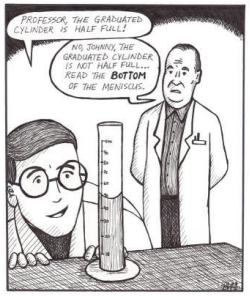
Volumetric flask

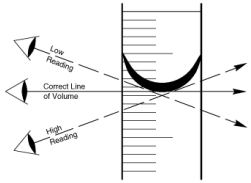
- A volumetric flask (measuring flask or graduated flask) is a piece of laboratory glassware, a type of laboratory flask, calibrated to contain a precise volume at a particular temperature.
- Volumetric flasks are used for precise dilutions and preparation of standard solutions.
- These flasks are usually pear-shaped, with a flat bottom, and made of glass or plastic.
- Solutions with definite concentrations only used in volumetric flasks.
- The neck of the volumetric flasks is elongated and narrow with an etched ring graduation marking. The marking indicates the volume of liquid contained when filled up to that point.
- Do not heat any volumetric equipment!

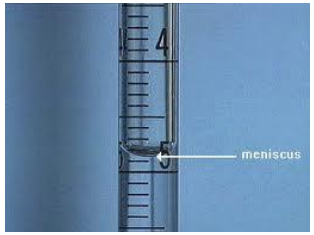
Graduated cylinder

- A graduated cylinder, measuring cylinder or mixing cylinder is a piece of laboratory equipment used to measure the volume of a liquid.
- Graduated cylinders are generally more accurate and precise than laboratory flasks and beakers. However, they are less accurate and precise than volumetric glassware, such as a volumetric flask or volumetric pipette.
- For these reasons, graduated cylinders should not be used to perform volumetric analysis.
- A traditional graduated cylinder is usually narrow and high (so as to increase the accuracy and precision of volume measurement) and has a plastic or glass bottom and a "spout" for easy pouring from the measured liquid.
- Do not heat any volumetric equipment!

Graduated cylinder

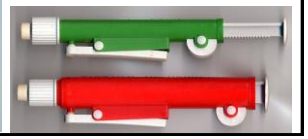






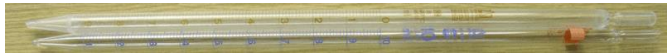
Graduated pipettes

- Graduated pipettes are a type of macropipette consisting of a long tube with a series of graduations, as on a graduated cylinder or burette, to indicate different calibrated volumes.
- They also require a source of vacuum; in the early days of chemistry and biology, the mouth was used. Graduated pipettes commonly come in 1, 2, 5, 10 and 25 mL volumes and they are highly accurate.
- To avoid accidental ingestion of potentially harmful substances, a variety of propipetters have been developed, both entirely manual and electrically assisted



Graduated pipettes

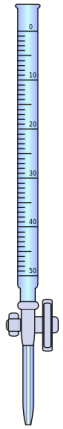
- Pipettes are made of borosilicate glass; disposable graduated pipettes are often made of polystyrene.
- Graduated pipettes are often graduated in one of two ways:
- Mohr, backward or drain-out pipettes have a 0 mL mark just above the end of the pipette.
- Serological, forward or blow-out pipettes have no 0ml mark as that corresponds to an empty pipette.
- Do not use graduated pippetes for measuring hot solutions or do not heat them!



Volumetric pipettes

- Volumetric pipettes or bulb pipette allow the user to measure a volume of solution extremely accurately (accuracy of four significant figures).
- These pipettes have a large bulb with a long narrow portion above with a single graduation mark as it is calibrated for a single volume (like a volumetric flask).
- Typical volumes are 10, 25, and 50 mL.
- Volumetric pipettes are commonly used to make laboratory solutions from a base stock as well as prepare solutions for titration.

Burette

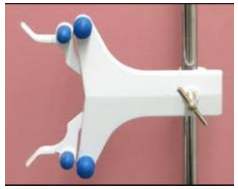


- A burette (also buret) is a device used in analytical chemistry for the dispensing of variable, measured amounts of a chemical solution.
- A burette is distinguished from a pipette by the fact that the quantity delivered is variable. Thus in a titration, one solution is dispensed with a pipette, and another solution is added to it from a burette in aliquots of varying size.
- Burettes may be designated for use at a particular temperature. If used at another temperature they should be subject to calibration.
- Do not heat volumetric equipment!

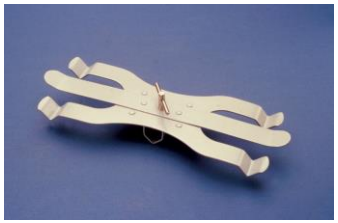
Retort Stand

- A retort stand, sometimes called a ring stand, is a piece of scientific equipment, to which clamps can be attached to hold test tubes and other equipment such as burettes which are most often used in titration experiments.
- It is also used in filtering, and extraction.
- The stands are usually made of a chemically impervious metal and may be covered with aluminium foil to further protect the base, on which may sit a hot plate, magnetic stirrer, heating mantle, or some other apparatus.

Burette Clamp



- A buret clamp is chemical or biological laboratory equipment.
- It is used for firmly holding test-tubes, burettes and other glassware in place when performing experiments such as titration.
- There are usually of two types, a single buret clamp and a double buret clamp.



Iron ring and clamp

- An iron ring, sometimes called an iron support ring, is used in chemistry labs to stabilize flasks mounted to a ring stand.
- Some iron rings include a clamp, while others require a utility clamp to attach to a ring stand.
- A test tube clamp is used for holding a test tube

Test tubes and Test tube rack

- A test tube, also known as a culture tube or sample tube, is a common piece of laboratory glassware consisting of a finger-like length of glass or clear plastic tubing, open at the top, usually with a rounded U-shaped bottom.
- Test tubes are available in a multitude of lengths and widths, typically from 10 to 20 mm wide and 50 to 200 mm long.
- A test tube has either a flat bottom, a round bottom, or a conical bottom.
- Some test tubes are made to accept a ground glass stopper or a screw cap.
- Test tubes are widely used by chemists to hold, mix, or heat small quantities of solid or liquid chemicals, especially for qualitative experiments and assays.

Mortar and Pestle

- The mortar is a bowl, typically made of hard wood, ceramic or stone.
- The pestle is a heavy club-shaped object, the end of which is used for crushing and grinding.
- The substance to be ground is placed in the mortar and ground, crushed or mixed with the pestle.

Evaporating Dish

- An evaporating dish is a piece of laboratory glassware used for the evaporation of solutions and supernatant liquids, and sometimes to their melting point.
- Most are made of porcelain or borosilicate glass.

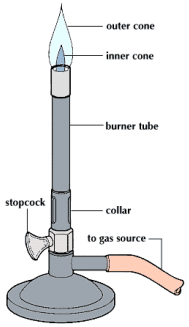
Crucible

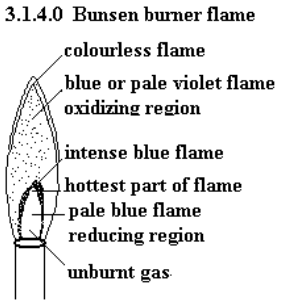
- A crucible is a container that can withstand very high temperatures and is used for metal, glass, and pigment production as well as a number of modern laboratory processes.
- While crucibles historically were usually made from clay, they can be made from any material that withstands temperatures high enough to melt or otherwise alter its contents.
- Crucibles are use for calcination.
- The calcination process involves heating a substance in a crucible or over an open flame until it is reduced to ashes.

Bunsen burner

- A Bunsen burner, named after Robert Bunsen, is a common piece of laboratory equipment that produces a single open gas flame, which is used for heating, sterilization, and combustion.
- The device in use today safely burns a continuous stream of a flammable gas such as natural gas (which is principally methane) or a liquefied petroleum gas such as propane, butane, or a mixture of both.
- The amount of air mixed with the gas stream affects the completeness of the combustion reaction.
- Less air yields an incomplete and thus cooler reaction, while a gas stream well mixed with air provides oxygen in an equimolar amount and thus a complete and hotter reaction.

Bunsen burner



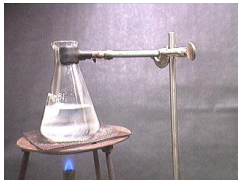


Pipeclay triangle

- A pipeclay triangle (or ceramic triangle) is a piece of laboratory apparatus that is used to support items being heated by a Bunsen burner or other heat source.
- It is made of wires strung in an equilateral triangle on which are strung hollow catlinite or ceramic tubes.

- The triangle is usually supported on a tripod or iron ring.
- Unlike wire gauze, which primarily supports glassware such as beakers, flasks, or evaporating dishes and provides indirect heat transfer to the glassware, the pipeclay triangle normally supports a crucible and allows the flame to heat the crucible directly.

Wire Gauze

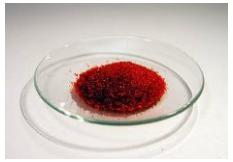


- There are two types of wire gauze used in chemistry: a normally woven wire gauze, and one with a white circle imprinted on it.
- The latter has a ceramic composite intended to aid in the dispersal in heat.
- The normal set-up is a ring stand which a support ring attached to it. The wire gauze is centered on the ring stand as to allow the open flame to be in contact with it to a certain extent, depending on the desired heat.
- In the context of laboratory experimentation, the combination of the wire gauze plus the added ceramic composite greatly aids in the even dispersal of heat.

Laboratory Tripod

- Laboratory tripod is a three-legged equipment, generally used as a platform of some sort.
- The word is derived from Greek word tripous, meaning "three feet".
- A tripod stand has three legs and is widely used in laboratories to conduct various experiments.
- This lab equipment is used to support and hold various flasks, beakers and other glass ware when not in use and also during experiments.
- The stands are specially constructed using light metals for light weight and ease of carrying.

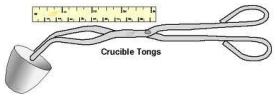
Watch Glass



- A watch glass is a circular, slightly convex-concave piece of glass used in chemistry as a surface to evaporate a liquid, to hold solids while being weighed, or as a cover for a beaker.
- The latter use is generally applied to prevent dust or other particles entering the beaker; the watch glass does not completely seal the beaker, and so gas exchanges still occur.
- When used as an evaporation surface, a watch glass allows closer observation of precipitates or crystallisation, and can be placed on a surface of contrasting colour to improve the visibility overall.

Tongs and Test Tube Holder

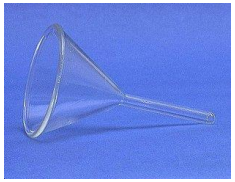
- Tongs are used for gripping and lifting tools, of which there are many forms adapted to their specific use.



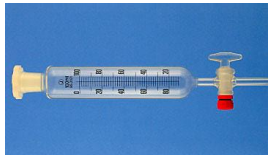
Ground glass joint

- Ground glass joints are used in laboratories to quickly and easily fit leak-tight apparatus together from commonly available parts.

Funnel

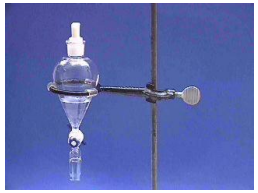


- A funnel is a pipe with a wide mouth, good for feeding, often conical mouth and a narrow stem.
- Laboratory funnels are funnels that have been made for use in the chemical laboratory.
- There are many different kinds of funnels that have been adapted for these specialized applications.
- Filter funnels, thistle funnels (shaped like thistle flowers), and have stopcocks which allow the fluids to be added to a flask slowly.



Seperatory Funnel

- A separatory funnel, also known as separation funnel, separating funnel, or colloquially sep funnel, is a piece of laboratory glassware used in liquid-liquid **extractions** to separate (partition) the components of a mixture into two immiscible solvent phases of different densities.
- Typically, one of the phases will be aqueous, and the other a non-polar lipophilic organic solvent such as ether, MTBE, dichloromethane, chloroform, or ethyl acetate.



Spatula and Glass Rod

- A spatula is a small implement with a broad, flat, flexible blade used to mix, spread and lift materials.
- Spatula is used for weighing chemicals.

- Glass rods (or stirring rods) are used as stirrers in laboratory environments.
- Like most laboratory glass, stir rods are made of borosilicate (commonly known as pyrex).

Forceps

- Forceps or forcipes are a handheld, hinged instrument used for grasping and holding objects.
- Forceps are used when fingers are too large to grasp small objects or when many objects need to be held at one time while the hands are used to perform a task.

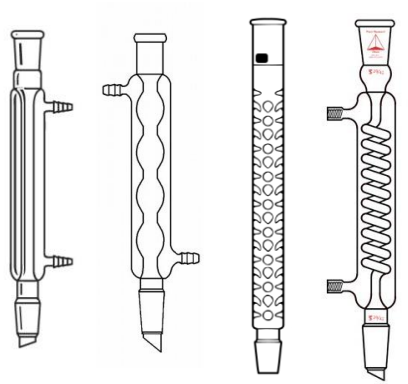
Wash Bottle

- A wash bottle is a squeeze bottle with a nozzle, used to rinse various pieces of laboratory glassware, such as test tubes and round bottom flasks.
- Wash bottles are sealed with a screw-top lid. When hand pressure is applied to the bottle, the liquid inside becomes pressurized and is forced out of the nozzle into a narrow stream of liquid.
- Most wash bottles are made up of polyethylene, which is a flexible solvent-resistant petroleum-based plastic. Most bottles contain an internal dip tube allowing upright use.
- Wash bottles may be filled with a range of common laboratory solvents and reagents, according to the work carried out in that lab.
- These include: deionized water, detergent solutions and rinse solvents such as acetone, isopropanol or ethanol.

Condenser

- A condenser is a piece of laboratory glassware used to cool hot vapors or liquids.
- A condenser usually consists of a large glass tube containing a smaller glass tube running its entire length, within which the hot fluids pass.
- The ends of the inner glass tube are usually fitted with ground glass joints which are easily fitted with other glassware. During reflux, the upper end is usually left open to the atmosphere or vented through a bubbler or a drying tube to prevent the ingress of water or oxygen.
- The outer glass tube usually has two hose connections, and a coolant (usually tap water or chilled water/anti-freeze mixture) is passed through it. For maximum efficiency, and to maintain a smooth and correctly directed thermal gradient so as to minimise the risk of thermal shock to adjacent glassware, the coolant usually enters through the lower fitting, and exits through the higher fitting.

Condenser



Liebig Condenser | Alihn Condenser | Vigreux Column | Graham Condenser

Desiccator

- Desiccators are sealable enclosures containing desiccants used for preserving moisture-sensitive items such as cobalt chloride paper for another use.
- A common use for desiccators is to protect chemicals which are hygroscopic or which react with water from humidity. Desiccators are sometimes used to remove traces of water from an almost-dry sample.

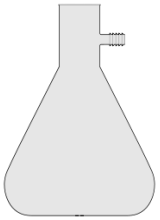
Round and Flat bottom flask

- Round-bottom flasks are types of flasks having spherical bottoms used as laboratory glassware, mostly for chemical or biochemical work.
- They are usually made of heat-resistant borosilicate glass.
- There is at least one tubular section known as the neck with an opening at the tip. Two or three-necked flasks are common as well.
- Reagent flasks are usually a flat-bottomed flask, which can thus be conveniently placed on the table or in a cabinet.
- These flasks cannot withstand too much pressure or temperature differences, due to the stresses which arise in a flat bottom, these flasks are usually made of weaker glass than reaction flasks.

Round and Flat bottom flask

Büchner funnel and flask

- A Büchner funnel is a piece of laboratory equipment used in filtration.
- It is traditionally made of porcelain, but glass and plastic funnels are also available.
- On top of the funnel-shaped part there is a cylinder with a perforated plate separating it from the funnel.



Filter Paper

- Filter paper is a semi-permeable paper barrier placed perpendicular to a liquid or air flow.
- It is used to separate fine solids from liquids or air.
- Filter paper comes in various porosities and grades depending on the applications it is meant for. The important parameters are wet strength, porosity, particle retention, flow rate, compatibility, efficiency and capacity.
- There are two mechanisms of filtration with paper; volume and surface. By volume filtration the particles are caught in the bulk of the filter paper. By surface filtration the particles are caught on the paper surface. Filter paper is mostly used because even a small piece of filter paper will absorb a significant volume of liquid

Pasteur Pipette

- Pasteur pipettes, also known as droppers or eye droppers, are used to transfer small quantities of liquids.
- They are usually glass tubes tapered to a narrow point, and fitted with a rubber bulb at the top.
- The combination of the Pasteur pipette and rubber bulb has also been referred to as a teat pipette.