

Lab Equipment & Lab Technique

It's important to know the names of the tools in your laboratory as well as how to use them. Proper knowledge and use of the equipment are safety factors as well. Always keep your equipment clean and neat and properly stored when not in use.

Lab Equipment

It's best to assume any equipment or tools you utilize in the laboratory need to be cleaned properly first. With exceptions noted by the instructor, always wash with soap and water and dry as thoroughly as possible any glassware and dissection tools. The soap used in laboratory is specially formulated to rinse well with cold water and not leave a soapy residue. Always rinse the glassware and tools in a very small amount of distilled water before drying.

Dissection Kit

For the majority of labs, you will be provided with a dissection kit (located in the student box or tray on your table).

At the beginning of each lab you should always check the kit to be sure it is complete. Below are listed the contents each kit should include, along with a brief description.

- scissors (1) - often used instead of the scalpel in cutting through material, especially biological specimens.
- blunt probe (1) - to tease tissue apart for better viewing.
- sharp probe (2) - similar to the blunt probe but it's often used in tearing tissue apart or for teasing apart fine layers of tissue.
- scalpel (1) - for cutting through tissue during dissection. Your scalpel has changeable blades. If you feel the scalpel is too dull for use, ask your instructor to change the blade for you.
- metric ruler (1)
- eye dropper (1)
- forceps (1) - also sometimes called tweezers
- single edge razor blade (1)
- lens paper (1 pk) - for cleaning lenses of microscope. This is especially manufactured lens paper to prevent any scratching of the objectives when cleaning.

Glassware, Porcelain, or Plasticware

Below is a checklist of glassware, porcelain or plasticware you may use from time to time in laboratory. Get to know the shapes and functions of each. Labware may be either plastic (Nalgene®) or glass, usually Pyrex® or Kimax®.

Pyrex® is a trademark of the Corning company and glassware marked Pyrex® may withstand certain extremes in temperature without cracking. Therefore, you may rapidly heat or rapidly cool this glassware without too much danger of breakage. If not marked Pyrex® or Kimax® it is not recom-



mended to use these with direct flames or hot plates. **Never heat plasticware!**

□ **Beakers** come in various sizes and are often marked (graduated) for volume. Some typical volumes are 10ml, 20ml, 30ml, 50ml, 100ml, 150ml, 250ml, 400ml, 500ml, 1000ml. Whatever the graduated volume of the beaker, it is usually accurate to only within + or - 5%. Never use the volumetric markings on a beaker when accuracy of measurement is essential.

□ **Erlenmeyer Flasks** are typically Pyrex® or Kimax® glass and often in the same graduated volumes as beakers. Flasks are typically used when the contents need to be stoppered. You will often use Erlenmeyer flasks when you need to insert glass tubes in stoppers and the glass tubes need to come into contact with any liquid in the flask or the space above the liquid. Rubber stoppers provide an air tight seal. Always moisten the rubber stopper with distilled water prior to inserting into the flask. This provides a better seal. Remember, there is usually a + or - 5% accuracy with these flasks so don't use them for exact measurements.

□ **Florence Flasks** are also called boiling flasks. Their rounded sides provide a more controlled boiling than Erlenmeyer flasks. They come in the same sizes and graduations and with the same lack of accuracy of measurement. A variation on the Florence flask is the round bottom flask - aptly named. This type of flask is ideal for boiling under controlled conditions.

□ **Volumetric Flasks** are especially designed to hold a very specific, very accurate volume of liquid. High up on the neck of the flask is a mark which surrounds the neck and this indicates the specified volume marked on the flask to within tolerances established by the American Society for Testing and Materials (ASTM).

□ **Graduated Cylinders** are glass or plastic cylinders graduated into fairly accurate divisions. These calibrations are more accurate than that of beakers and Erlenmeyer flasks and approach that of volumetric flasks. When more accurate measurements are called for, always use either graduated cylinders or pipettes.

□ **Filter Flasks** are very thick-walled flasks that for all appearances are like the Erlenmeyer flask. However, there is a small opening on the side leading into a short, corrugated extension. This extension is where you attach a rubber hose to the flask and to the faucet. By running water through the faucet and across the opening in the



hose, you create a vacuum. This is known as the Bernoulli effect. When coupled with a Buchner funnel, this flask is excellent for filtering large quantities of material in short order.

□ **Culture Dishes**, in spite of their name, are an all purpose, stackable dish used in the biology laboratory. They are often used to hold live specimens, and as the name implies, grow them over a period of time for laboratory use. They are also used to display preserved specimens in lab.

□ **Petri Dishes** are named, according to Wikipedia, after the German bacteriologist who invented it, Julius Richard Petri, an assistant of Robert Koch. They are used to culture bacteria. Each dish consists of a base and a lid. Glass dishes are autoclaved to sterilize the dish to prevent contamination of cultures. Today, the plastic, presterilized Petri dish has pretty much replaced the glass version. Always pick up the Petri dish in a way the lid remains attached to the base and no air slips in.

□ **Watch Glasses** are glasses with a convex and concave surface which may be placed over other glassware to observe the events of an experiment. It's a means of protecting you while watching what is going on in the reaction vessel. These glasses are also used to serve as a surface upon which to condense materials. In biology lab, they are useful for placing very small specimens for observation under dissection scopes.

□ **Pipettes** are graduated tubes used to accurately dispense specific amounts of liquids. Pipettes come in various sizes and volumes. The most commonly used volumes are 1ml, 5ml and 10ml pipettes. A variation on the pipette is the volumetric pipette which dispenses only the indicated volume marked on the pipette. In this sense, it's like the volumetric flask.

□ **Pasteur Pipettes** are variations on the eye dropper. The end of the pipette is drawn into a very fine taper. These pipettes are often used when trying to remove a particular layer of material from a test tube. For example, if you were trying to remove only the sediment from a test tube that contained sediment and supernatant, Pasteur pipettes would be an excellent choice for the procedure.

□ **Glass Stirring Rods** are used when a nonreactive material must be used to stir solutions.



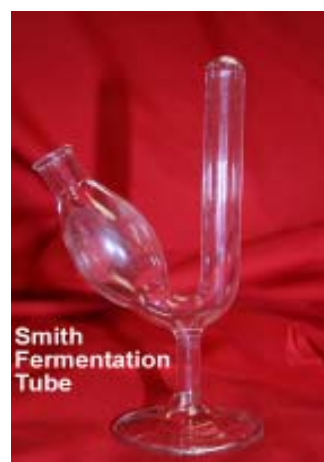
Some come with a rubber tip and are used much the same way spatulas in kitchens.

□ **Durham's Tubes** are designed for use in fermentation experiments. It consists of a screw-cap test tube with a very small test tube with exact diameter. The smaller test tube is inverted into the larger test tube and then filled with liquid. As fermentation occurs, then gas is produced in the smaller tube displacing the liquid. The amount of gas production can be roughly estimated by the size of the smaller tube.

□ **Smith Fermentation Tubes** are designed to demonstrate fermentation. They work on the same principle as the Durham tube - gas production - but simplify the procedure by using on U-shaped tube where the liquid is forced into the end of the Smith tube and trapped by atmospheric pressure. Gas produced in the tube forces any excess liquid out of the Smith tube.

□ **Reagent Bottles** are designed to hold hazardous chemicals such as acids and bases. The intent of the design is to prevent the user from placing the stopper down on the table and therefore reduce the possibility of contamination or spills. The stopper, as well as the mouth of the reagent bottle is ground glass. This ensures a fairly tight fit. When lubricated with stopcock grease or petroleum jelly, this forms an air tight seal. Most reagent bottles need to breathe a little to release pressure from the liquid. Whenever using a reagent bottle, always loosen the stopper first before removing. Make sure the stopper is held in the same hand as the reagent bottle when dispensing liquids from the bottle.

□ **Barne's Dropping Bottles** are the workhorse of biology labs. Many small amounts of chemicals required in experiments at your work space are often stored in these bottles. This prevents you from having to dispense liquids from large, unwieldy containers which increase the chance of spillage. Notice Barne's bottles are designed so you cannot set the stopper down on the table and thus run the risk of contamination of the solution.



□ **Funnels** are used to reduce spills when dispensing liquids into containers or to filter substances. There are two basic funnel types used in laboratory: glass or plastic funnels and the Buchner funnel. The glass or plastic funnel is the type you may have seen around the home. Simply insert the funnel into the container you wish to pour a liquid. They can also be used to filter substances when used in conjunction with filter paper. Fold a round of filter paper into quarters and then spread open and fit into the funnel. You will often wish to mold the filter paper to the funnel using distilled water or the substance you are filtering. Buchner funnels are designed to be used with the filter flask. You don't use filter paper with the Buchner funnel but prepare a slurry of diatomaceous earth to serve as the filter. The slurry is poured into the Buchner funnel and then gently vacuumed into position using the filter flask.



□ **Evaporating Dishes** are sometimes the simplest way to separate a liquid from a solid mixture. For example, to separate a solution of salt water, you can simply place the solution in an evaporating dish and add heat, usually through a ring stand, wire gauze and Bunsen burner. Boiling away the water will leave a salt residue in the evaporating dish. Of course, you don't necessarily need heat - simple evaporation works as well.



□ A **Crucible** is a vessel used when very high heats are required, particularly when melting solids or driving water from compounds. They may also be used when carrying out a chemical reaction which requires heat as activation energy. Crucibles have lids that may be placed over the vessel to control the rate of the reaction and you should always have on hand a set of crucible tongs when utilizing a crucible.



□ **Desiccators** are chambers in which a desiccant is added to remove water vapor. They are especially useful when slow drying is required. Desiccants can be of several types including clays, silica gels or anhydrous compounds such as anhydrous calcium sulfate. The desiccant often turns blue when it has absorbed too much moisture; the result of a chemical reaction with cobaltous chloride. Desiccators are most often used when some substance would normally absorb water



vapor from the air or if you need to dry something over a long period.

□ **Spot Plates** are typically white porcelain plates with depressions. They are most useful when trying to compare colors of one or more substances to others or to compare the way one substance reacts to a particular chemical. For example, spot plates are often used when trying to determine a positive test for starch. Powdered starch is placed in a depression on the spot plate and iodine is added. Iodine turns starch blue, purple, or black. If you wish to determine if a substance contains starch, place that next to the starch test and add iodine. The white background of the spot plate allows a color comparison.

□ The **Mortar and Pestle** are used for grinding. They are the mainstay of pharmacists and are often used in laboratory when you must grind together two or more solids. The pestle is held in the hand with the base of the pestle pushing against the bowl surface of the mortar.

□ **Bell Jars** are large glass jars which may be used for growing plants under very specific conditions, *e.g.* no carbon dioxide. They are also used with vacuum pumps to create a vacuum. In a pinch, they may excel-ent display units.

□ **Burets** are graduated tubes similar to pipettes except they are designed to hold the liquid which then can be dispensed slowly, drop by drop through a stopcock. You regulate the amount of liquid flowing through the tip of the buret tube by controlling the stopcock. Burets are often used in titration experiments. Today, you can purchase digital burets with automatic dispensing.

□ **Capillary Tubes** are extremely small diameter bore tubes which exert capillary action when in contact with

liquids. Capillarity is the polar effect of water molecules which adhere to the sides of a charged surface - the glass tube. Most capillary tubes have an overall negative charge associated with the surface, so the positive end of water adheres to the surface of the tube pulling a liquid into the tube. Capillary tubes are excellent devices to pull up small amounts of liquid and dispense the liquid to an exact spot. They work much like a soda straw when you place your finger over the tip to trap the liquid and then release your finger to release the liquid in the straw.

□ **Whatman Jars** are primarily used in staining microscope slides. The jar has glass grooves



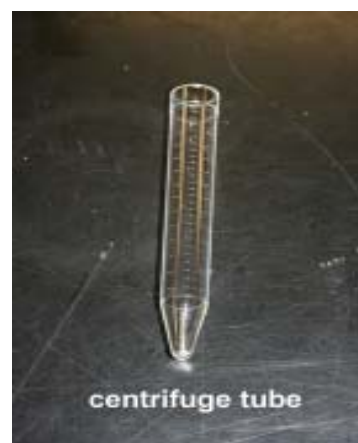
into which slides fit and are held a set distance apart from other slides. This allows any stain to reach any and all parts of the tissue on the slide without the other slides coming into contact. At BCC, we seldom use Whatman Jars for staining. Instead, we often use Whatman Jars in thin layer chromatography where chromatography slides are inserted in a chromatography solvent.

□ **Centrifuge Tubes** are especially designed tubes with tapered ends. These tubes fit into preformed slots in centrifuges. When spun at high speed, the tapered ends of the tube aid in collection of the sediment. Most of the centrifuge tubes you will use in lab are plastic and they often crack at high speeds. Anytime you have a cracked centrifuge tube, be sure to dispose of it after the exercise. Most of these tubes come with caps. Never use the cap when centrifuging - remove it prior to inserting into the centrifuge. You may use the cap after you remove the centrifuge tube from the centrifuge. It's essential to always balance centrifuge tubes carefully. You always centrifuge in pairs opposite each other in the centrifuge. Always prepare two tubes of exactly the same volume in each tube. If they are not exactly the same volume and not directly opposite each other, the centrifuge can be damaged.

□ **Separatory Funnels** are used to separate liquids of different densities or compounds of varying solubilities. The densest liquid settles to the bottom and then can be decanted through a stopcock at the base of the funnel. In biology lab, the separatory funnel is most often used to separate compounds of different solubilities.

□ **Hydrometers** are used to determine the specific gravity of various solutions or mixtures. Each has a small weight in the end. The hydrometer is often used in conjunction with a graduated cylinder or clear cylindrical tube. The solution for which the specific gravity is to be determined is added to the tube and the hydrometer is floated in the solution. The level of the liquid to the stem of the hydrometer tells you the specific gravity.

□ **Eppendorf Tubes** are small plastic tubes with tapered ends. They can be used in microcentrifuges or they can serve as containers for materials or organisms which must be chilled to below freezing temperatures for long term storage. They are most often used in microbiology.



Miscellaneous Laboratory Tools

□ **Beaker Tongs** are essential when removing a beaker from a heat source, whether a hot plate, Bunsen burner, or microwave. They are specially designed to grasp around the rim of beakers.

□ **Spatulas** are tools designed to remove amounts from reagent containers, much like spoons are used to remove sugar from a sugar bowl. They come in various shapes, sizes, and lengths. Always be sure you measure with a clean spatula.

□ **Ring Stands** are used to hold various laboratory apparatuses. In particular, a ring clamp can be attached to suspend an evaporating dish or crucible over a Bunsen burner. Other clamps may also be attached to hold various vessels in specific positions. In the image shown, a buret clamp has been attached to the ring stand.

□ There are all types of **Clamps** available in the biology and chemistry lab. All are designed to hold glassware or other apparatus in place. This particular one is a single buret clamp.

□ **Inoculating Loops** are used in microbiology to transfer bacterial cultures from one container to another. The term loop comes from the tiny loop found at the end of the device which collects the bacteria. They are designed to be heated to a glowing cherry red to sterilize the loop prior to use and after the bacterial transfer.

□ A **Water Aspirator** is used in conjunction with a filter flask or any other apparatus which requires a vacuum. It uses the Bernoulli's effect of water rushing past an opening to create the vacuum.



Instrumentation

□ The **Spectrophotometer** or **Spec 20** is used in biology and chemistry laboratories to measure either transmittance or absorbance in a liquid chemical reaction. The Spec 20 uses plane polarized light which is transmitted through the test material. Any absorbance (or transmittance) can be measured by an electrode opposite the solution tested.



□ **Triple Beam Balances** are so named for the three different mass units associated with three long rails on the balance. One rail measures in the tenths of grams, another in grams and the third in hundreds of grams. These are very good balances for determining the mass of rather large objects. You must always zero the balance prior to any mass determination and you must always take into consideration any container which may be used. For example, if I wished to measure 30 grams of sodium chloride, a solid, I would use a weighing "boat" or glassine weighing paper and the triple beam balance. You need to first weigh the "boat" empty to determine the mass of the boat. Let's say it has a mass of 1 gram. Now fill with the amount of sodium chloride needed. In this case, you will need to add enough sodium chloride to make the scale read 31 grams (1 gram for the boat).



□ **Digital Balances** are similar to the triple beam balance but the readout is electronic. There is also an automatic tare feature which zeros the balance to the mass of the weighing "boat" or glassine paper. Generally, digital balances are useful for smaller amounts of material. Unfortunately, sometimes air currents in the room provide inaccurate readings. Therefore, many digital balances come with a "hood" to block air currents. You will notice students have been especially harsh to this balance by not cleaning up any spills of chemicals and not using boats or glassine papers. Always immediately clean up any spills to any balance.



□ The **Waring Blender** was invented by Fred Waring, a big band leader in the 1950's, as a device to make cocktails. However, scientists soon found additional uses. In the laboratory, the Waring blender is often used to fractionate cells to release their organelles into solution. The resultant filtrate can then be centrifuged to separate the organelles by mass.



□ A **Vortex** is used to resuspend the pellet in a



centrifuge tube after centrifugation and the supernatant has been decanted. Simply place the Ependorf, centrifuge or test tube in the rubber support and the tube is vigorously agitated. The same effect may be obtained by holding the tube between your thumb and forefinger and gently tapping with your other forefinger.

□ The Stirring Hot Plate allows you to stir solutions using the magnetic stirring bars at the same time you heat the solution. This speeds the dissolving process.

□ **Magnetic Stirrers** are used when you must agitate mixtures for long periods of time in order to cause the contents of the mixture to go into solution. They are used in conjunction with a magnetic hot plate which can heat the solution at the same time as the solution is being dissolved. There are different sizes for different volumes of solutions.

□ **Centrifuges** are delicately balanced instruments which spin at very high speeds (g forces) in order to settle out particles based on mass. The heavier particles are pushed to the bottom of centrifuge tubes. When using a centrifuge, great care must be taken to balance the tubes in the centrifuge. Each tube must have a tube directly opposite in the centrifuge and the tubes must contain exactly the same amount of material. Otherwise, the centrifuge is out of balance. At high speeds, this can damage the rotors.



Electrophoresis Apparatus

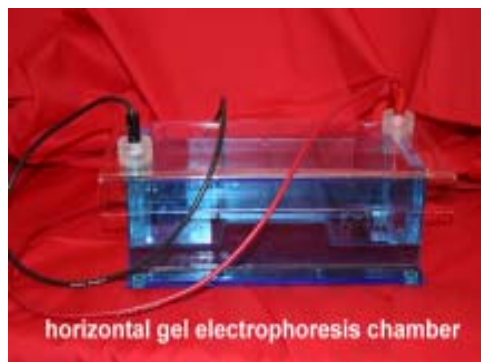
□ The **High Voltage Power Supply** is used in electrophoresis experiments where a very high voltage is required to drive charged particles or particles of different sizes through agarose gels. They are used in conjunction with electrophoresis chambers. This particular model has two different voltage levels as well as the ability to connect two electrophoresis chambers at one time.

□ The **Electrophoresis Chamber** is used to hold the electrophoresis gel bed and the buffer solution used in electrophoresis separation. The chamber has exposed platinum electrodes, and as such, should never be roughly washed. Instead, only rinse these

with distilled water and let them air dry. The chamber is designed in such a way as to hold a specific amount of buffer solution and a gel bed with combs. A lid seals off the experiment to protect from electrical shock. There is always a little gap left between the lid to allow hydrogen and oxygen gases to escape and not explosively build up. There are two types: horizontal and vertical chambers. Vertical chambers are most often used with density gradient gels.

□ The **Electrophoresis Gel Bed** fits inside the electrophoresis chamber. The ends are sealed off with tape or with plastic dams and a melted agarose gel is poured into the bed. Combs are inserted at specified locations to form “wells” in the solidified gel. Once solidified, the tape or dams are removed and the bed is placed inside the chamber. Buffer is added to completely cover the gel bed and gel. The combs are then removed to provide the wells or spaces in which to load the electrophoresis sample.

□ **Micropipettes** are rigidly designed for delivery of very small, very exact amounts of material - usually microliters. They have especially designed disposal tips that fit over the end of the pipette. Usually, you dial the amount of liquid you wish to pull into the pipette. You dispense the liquid by depressing on a plunger. To discard the pipette tip there is a release lever. Micropipettes are often used in microbiology and gel electrophoresis. Specific volumes are obtained by “dialing” the required volumetric amount.



□ **Staining Trays** are used for either microbiology staining or for gel electrophoresis staining. The one shown here is for gel electrophoresis staining, but it could be also used in microbiology.

