APPENDIX

A) General Experimental Guidelines

The laboratory is a critical component of your study of chemistry. ***Therefore, a student must complete all of the assigned laboratory work, including all on- & off-line post-laboratory exercises, in order to pass this course.***

1. Pre-Laboratory Preparation

Many of the Chemistry 2 laboratory experiments are intricate and use chemicals that could present a hazard if used improperly. Thus, students are required to judiciously prepare for each experiment by carefully reading the experiment and writing a Title, Purpose, Procedure (brief outline), and Data (outline) section before arriving at the laboratory. A detailed description of each section is described below under, "Writing a Laboratory Report". After preparing the laboratory notebook, students will complete the on-line pre-laboratory presentation and must pass the pre-laboratory quiz. ***Any student without this preparation completed*** at the beginning of the laboratory period is deemed unsafe and must leave the laboratory until the pre-laboratory write up is complete and the supervising TA is convinced that you are prepared to begin the experiment.

2. Data Collection

All data must be recorded ***in ink*** directly into your laboratory notebook. At the completion of the experiment, you must turn in a copy of your data sheet to your TA ***before*** you leave the laboratory.

3. Unknowns

Students will obtain all unknowns from the TA. Students must be explicit in their request for an unknown; that is, they must know the name of the experiment and unknown. If a student needs more unknown, they should notify the TA who will then write a note of explanation that the student can take to the dispensary. The note should contain the student's name, the student's locker number, the laboratory section number, the TA's name, the experiment name, and the name of the unknown.

4. Writing A Laboratory Report

Below is the suggested format that your report should follow. Portions of the report should be written in your laboratory notebook and others will be submitted on-line as part of the post laboratory exercises. Post laboratory exercises are ***due one week*** after the completion of the laboratory.

Below is a general outline of a common format that is often used in science laboratory courses. Discuss this format with your TA during the first laboratory period so that you clearly understand what will be expected.

> **Title**: The report should have a title that concisely describes the experiment.

Purpose: A brief and concise statement that describes the goals of the experiment and the methods employed. Any pertinent chemical reactions are generally indicated. State the purpose of the experiment in the form of a complete sentence. Do not start with the word "To."

Procedure: A brief and concise outline of each step of the experiment should be included. If you are using a published procedure, you should also cite the literature or laboratory manual. A drawing of the apparatus may also be included.

Data and Observations: Report all measurements and observations that are pertinent to the experiment. Be sure to note any problems or unexpected occurrences. It is important that this section be as ***neat*** and as ***organized*** as possible. The use of tables will often help in this regard. All data must be ***recorded in ink*** directly into the notebook at the time it is collected. A severe penalty will be imposed for pencil or transcribed data entries. Do not erase mistakes. Simply draw a line through the error and record the correction. Your notebook is subject to examination at any time.

The following sections are to be submitted on-line as part of the post-laboratory exercise:

Calculations: This section generally includes any complicated calculations that are involved in the experiment. Again, it is important to use foresight when organizing this section.

Questions: All assigned questions are answered in this section.

Results & Conclusions: Report the outcome of the experiment.

All reports must be written in ***non-erasable ink***. A date should be indicated on each report, especially in the Data section. You must prepare for each experiment by writing the Title, Purpose, and Procedure ***before*** coming to the laboratory. It is also important to organize and prepare the format of the Data section before coming to the laboratory so that you will only need to ***neatly*** record your data and observations during the experiment. Each section should be clearly marked with a proper heading. Your notebook should be organized and written in such a manner that another chemist could read it and repeat the experiment in precisely the same way. It is also important to complete the report as soon as possible after the completion of the experiment as this is much more efficient than waiting until the night before the experiment is due.

5. Statistical Treatment of Data

Every measurement made in the laboratory is subject to error. Although you should try to minimize error, two types of errors will occur. Systematic or Determinate Errors are those errors which are reproducible and which can be corrected. Examples are errors due to a miscalibrated piece of glassware or a

balance that consistently weighs light. Random or Indeterminate Errors are due to limitations of measurement that are beyond the experimenter's control. These errors cannot be eliminated and lead to both positive and negative fluctuations in successive measurements. Examples are a difference in readings by different observers, or the fluctuations in equipment due to electrical noise.

You will be graded by your ability to obtain accurate results. Accuracy describes how close your result is to the true value. Another related term is precision. Precision describes how close your results from different trials are to each other. Data of high precision indicates small random errors and leads experimenters to have confidence in their results. Data that is highly accurate suggests that there is little systematic error. A well-designed experiment (and a well-trained experimenter) should yield data that is both precise and accurate.

In an effort to describe and quantify the random errors which will occur during the course of the Chemistry 2 laboratory you will be asked to report an average, a standard deviation, a 90% confidence limit, and a relative deviation. You may also have to analyze multiple trials to decide whether or not a certain piece of data should be discarded. The following sections describe these procedures.

Average and Standard Deviation
The average or mean, x, is defined by

$$x = \frac{\Sigma x_i}{N}$$

where each x_i is one measurement and N is the number of trials or samples.

The standard deviation, σ, measures how close values are clustered about the mean. The standard deviation for small samples is defined by

$$\sigma = \sqrt{\frac{\Sigma (x_i - x)^2}{N - 1}}$$

The smaller the value of σ the more closely packed the data is about the mean, or, in other words, the measurements are more precise.

Confidence Limits
Confidence limits provide an indication of data precision. For example, a 90% confidence limit of $\pm$ 2.0 indicates that there is a 90% probability that the true average of an infinite collection of data is within $\pm$ 2.0 of the calculated average of a limited collection. Clearly the more precise a set of data, the smaller the confidence interval. Thus, a small confidence interval is always the goal of any experiment. In General Chemistry you will be required to calculate the 90% confidence interval for all experimental collections of data. The formula to do this is:

$$\text{Confidence Limit} = \frac{t\,\sigma}{\sqrt{N}}$$

where t varies with the number of observations. For the 90% confidence limits you are asked to calculate, t = 6.314 when N = 2, t = 2.920 when N = 3, t = 2.353 when N = 4, t = 2.132 when N = 5, and t = 2.015 when N = 6. You should always report your result as the average ± the 90% confidence limit.

Relative Deviation

The relative average deviation, *d*, like the standard deviation, is useful to determine how data are clustered about a mean. The advantage of a relative deviation is that it incorporates the relative numerical magnitude of the average.

The relative average deviation, *d*, is calculated in the following way.

a) Calculate the average, x, with all data that are of high quality.
b) Calculate the deviation, $|x_i - x|$, of each *good* piece of data.
c) Calculate the average of these deviations.
d) Divide that average of the deviations by the mean of the *good* data.

This number is generally expressed as parts per thousand (ppt). You can do this by simply multiplying by 1000.

Please report the relative average deviation (ppt) in addition to the standard deviation in all experiments.

Analysis of Poor Data: Q-test

Sometimes a single piece of data is inconsistent with other data. You need a method to determine, or test, if the data in question is so poor that it should be excluded from your calculations. Many tests have been developed for this purpose. One of the most common is what is known as the Q test. To determine if a data should be discarded by this test you first need to calculate the difference of the data in question from the data closest in value (this is called the "gap"). Next, you calculate the magnitude of the total spread of the data by calculating the difference between the data in question and the data furthest away in value (this is called the "range"). You will then calculate the Q_{Data}, given by

$$Q_{Data} = \frac{\text{gap}}{\text{range}}$$

and compare the value to that given in the table below. The values in the table below are given for the 90% confidence level. If the Q_{Data} is greater than the $Q_{Critical}$ then the data can be discarded with 90% confidence (the value has a less than 10% chance of being valid).

Number of Trials	$Q_{Critical}$
3	0.94
4	0.76
5	0.64
6	0.56

While the Q test is very popular, it is not always useful for the small samples you will have (you will generally only do triplicate trials).

Keep in mind that you also always have the right to discard a piece of data that you are sure is of low quality. That is, when you are aware of a poor collection. However, beware of discarding data that do not meet the Q test. You may be discarding your most accurate determination!

B) On-line Pre- & Post-Laboratory Procedures

The Department of Chemistry is introducing on-line pre-& post-laboratory activities. The purpose of the pre-laboratory presentations is to aid the student in preparing for the laboratories. Each post-laboratory exercise is designed to guide you through the calculations or concepts that apply.

Prior to doing any activities, all students are required to complete the Safety Quiz online after watching the online safety videos. ***Prior to coming to the laboratory class,*** the pre-laboratory exercises are to be viewed and the pre-lab quiz must be completed on-line.

Read your Laboratory Manual and complete your pre-laboratory write up before viewing on-line pre-laboratory presentation.

Have laboratory notebook and calculator with you when viewing the on-line pre-laboratory presentation or completing the post-laboratory exercises. ***Plan ahead.*** As with any computer activity, the on-line activities may take time to complete. Do not wait until the last minute to complete any of the required on-line activities.

1. Accessing the Website

Each time you access the On-Line Chemistry 2 Laboratory website you must do so by logging into MyUCDavis. If you do not log in through your Chemistry 2 Course Webpage on MyUCDavis, then you will not be able to take the pre-lab quizzes or do the post-lab exercises.

a. All registered students have a UCD login with kerberos password in order to access the site. (If you are registered – proceed to item c below)

b. Concurrent students need to contact the Head TA to request guest access to the website in addition to obtaining a UCD login with kerberos password. A UCD login and kerberos password may be obtained from IT Express located in Shields Library.

1) Go to http://email.ucdavis.edu/forms/forms.html

2) Near the bottom of the page, click on "Temporary Affiliate Form."

3) Download and print this form.

4) Fill out your portion of the form indicating that your affiliation will be expected to terminate at the end of the current quarter.

5) Take the form to your Head TA to sign as the sponsor.

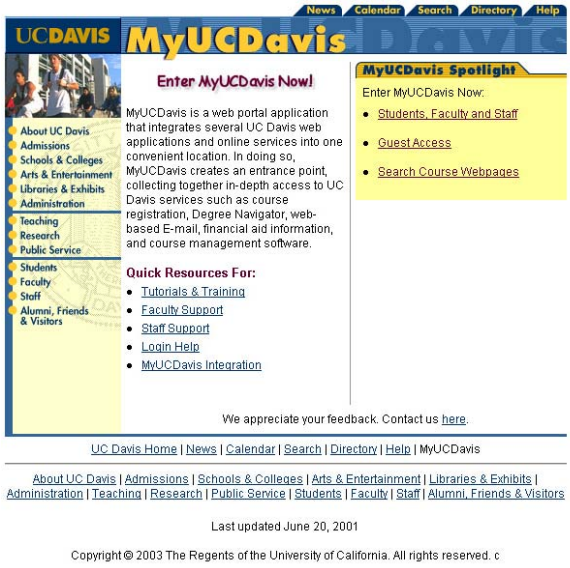
6) Take the form to room 108 Chemistry for Departmental Approval to be signed by George Hague, Chemistry Department MSO. Please note that George Hague will not accept your form until your Head TA has signed.

7) Take the completed form to IT Express in room 182 Shields Library and follow their instructions to obtain your UCD login and email accounts.

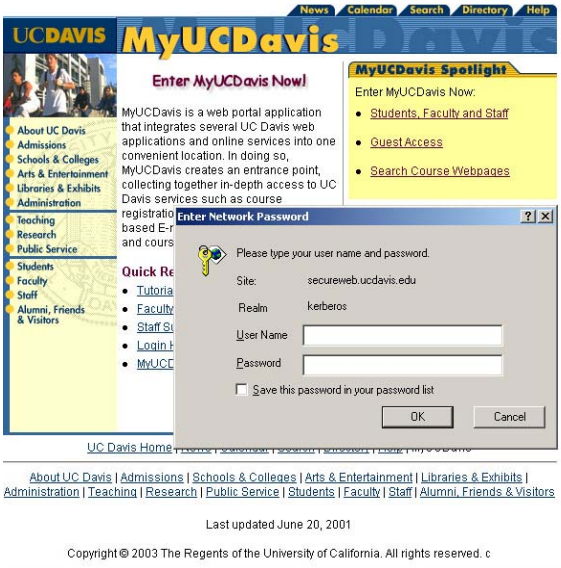
8) Once you have your UCD login and email account activated, contact your Head TA with your UCD email address so that the Head TA may give you MyUCDavis access to Chemistry 2.

c. Logging in

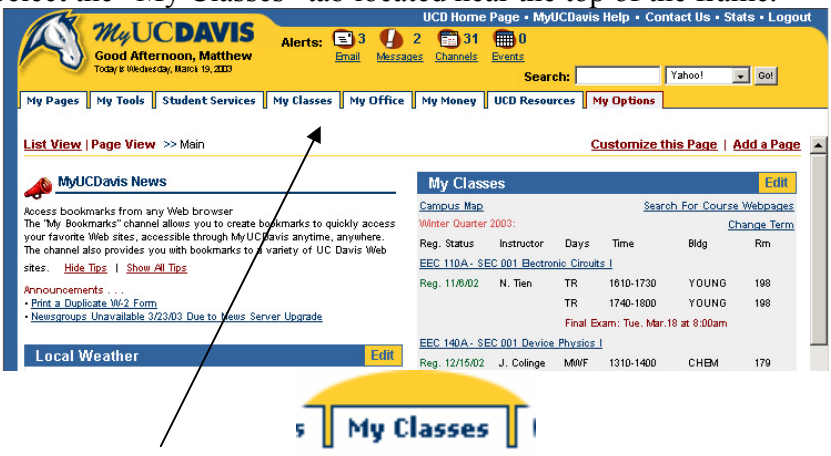
1) Go to http://my.ucdavis.edu.



2) In the upper right-hand corner of the MyUCDavis Welcome page is a “Students, Faculty, and Staff” link. Click on it and log in using your UCD login ID and kerberos password.



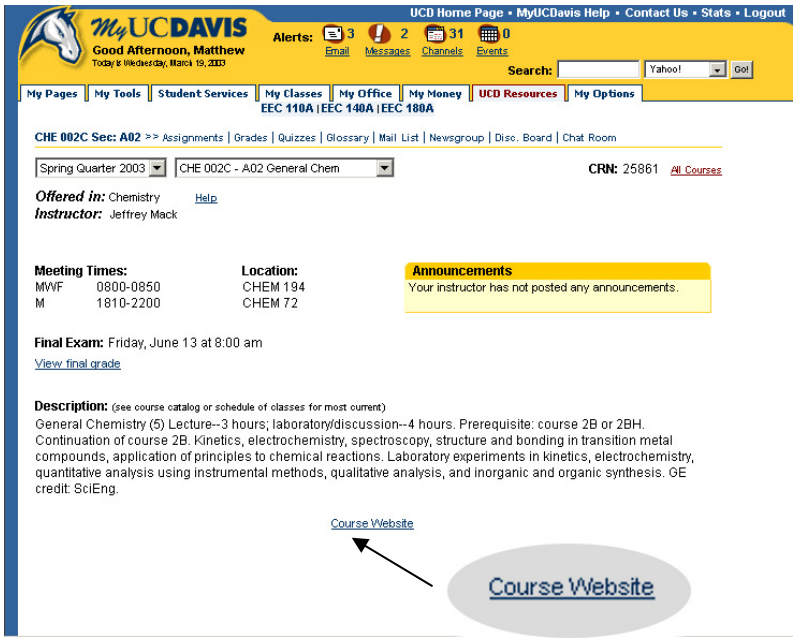
3) Select the “My Classes” tab located near the top of the frame.



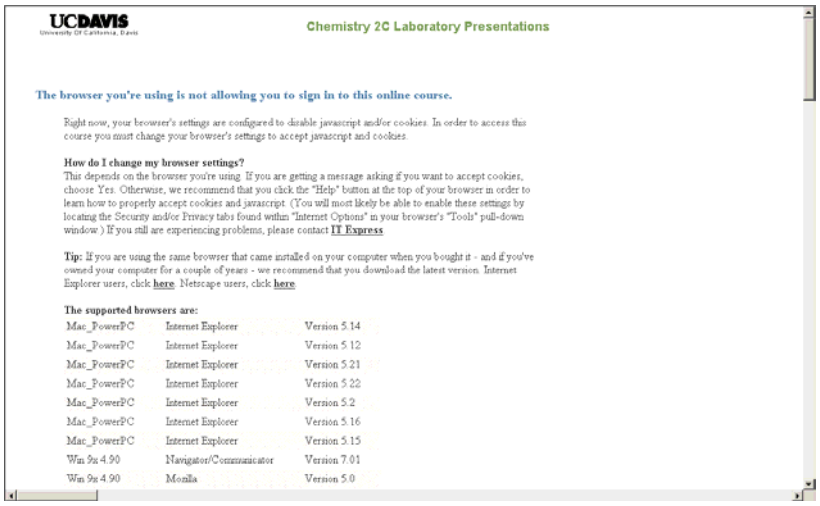
4) If you are using a modem or a slow DSL connection, be sure to place the CD in your CD Drive before proceeding.

5) Click your Chemistry 2 class.

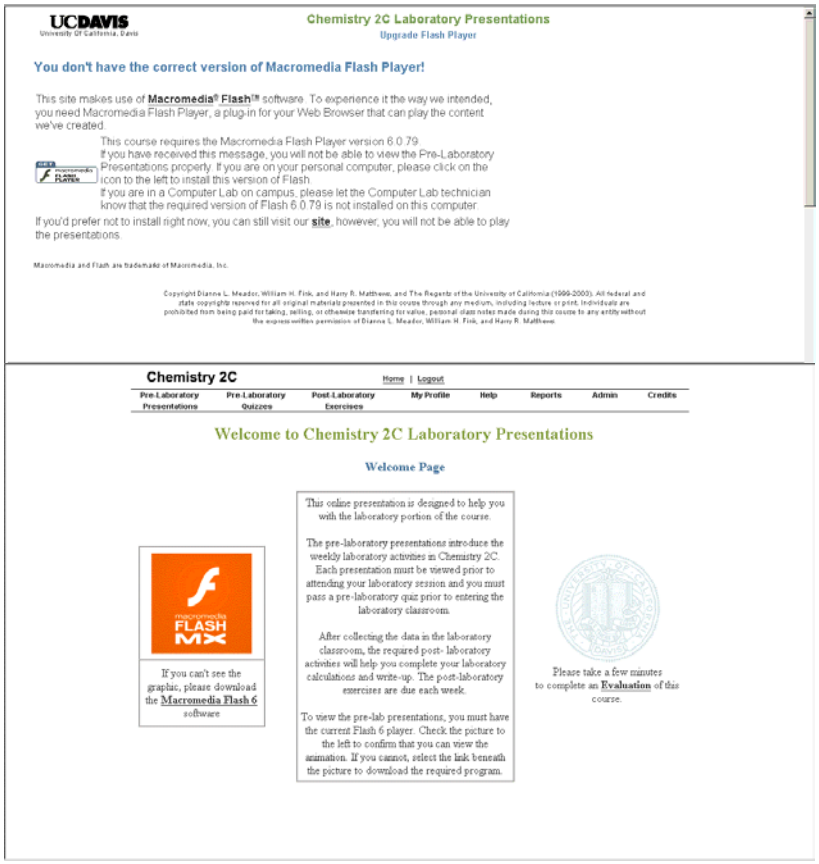
6) Following the course description paragraph, you will find a blue link named, “Course Website.” Click on this link.



7) You may see the screen below. This is checking your computer to make sure you have all the software and settings needed to view the course materials. Please follow the instructions to correct your settings and/or install the correct software. If you decide to bypass these tests, then there is no guarantee that you will be able to view all the videos and slides.



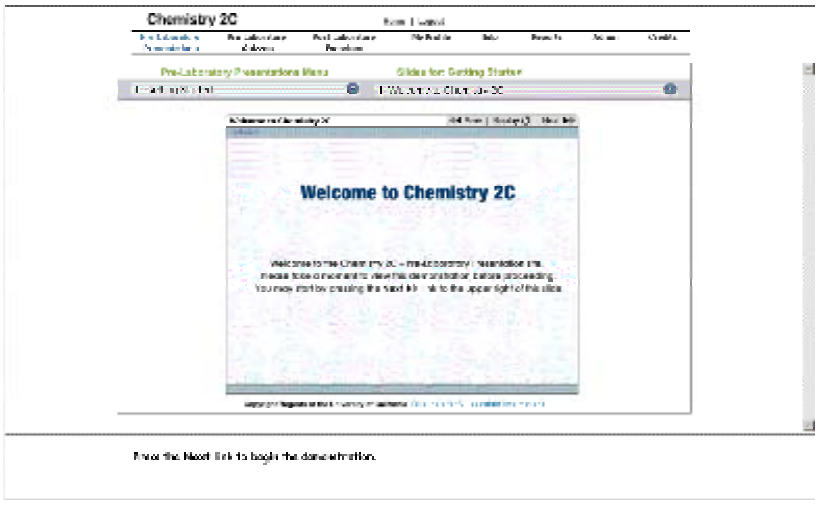
8) The Welcome Page tests whether the Flash plug-in is working. If you do not have the correct Flash player installed, you may see the following screen. Please follow the instructions to download and install the Flash Player. Keep in mind that downloading the plug-ins, i.e. Flash player, does not necessarily install them. Be sure to check the website you are downloading from for specific instructions on installing the plug-in. If you do not see the movie on the Welcome page, then there is no guarantee that you will be able to view all videos and slides.



9) Click on "My Profile" to enter your personal information. If you would like to change your password, you may do so at this page. At the "My Profile" page, you have the option to use the CD that accompanies this course or the no-CD option. If you choose to use the CD, then make sure you select the right drive for your CD-Rom drive. Whichever CD option you choose, the program will use it as the default option for subsequent logins. You can change this option any time.

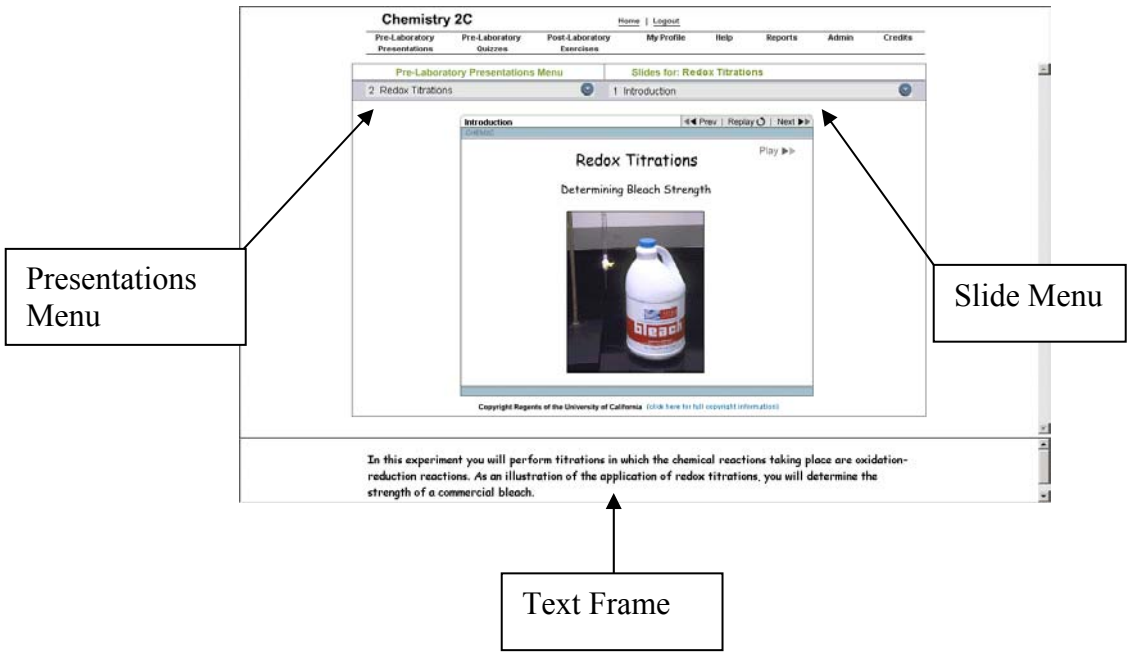
2. Viewing the Pre-laboratory Presentations.

a. If you click on "Pre-Laboratory Presentations," it will take you to the Pre-Laboratory Presentation screen as seen below. There is a brief tutorial in the "Getting Started" Presentation.



NOTE: If you run into difficulty with any of these steps, please contact **mwwebhelp@ucdavis.edu**.

b. Sequentially view the slides by either clicking on "Prev" and "Next" buttons, or view any slide in the presentation by selecting it in the Slide Menu. Note you may review any slide at any time.



c. The entire text for each slide may be viewed by moving the slider directly to the right of the text frame.

d. Audio is provided but not essential. All the information is conveyed in the text and the main frame.

3. Taking the Pre-laboratory Quiz

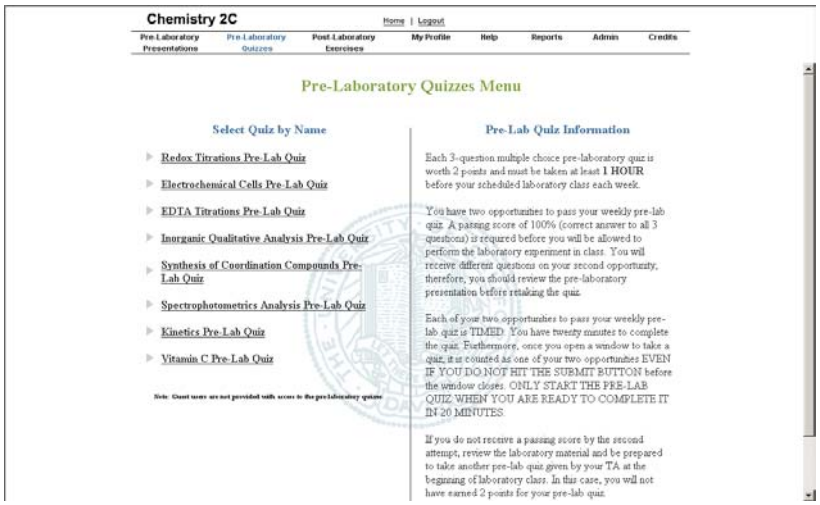
After viewing the lab session, go back to the Chemistry 2 Laboratory Presentation Home Page by clicking at the top of the page.

a. Click on pre-laboratory quizzes. Choose the appropriate laboratory quiz. Each pre-lab quiz must be completed ***at least 1 hour*** prior to attending your scheduled lab class. A passing score of 100% (correct answers to all three questions) is required before you will be allowed to perform the laboratory experiment. If you fail the quiz on the first attempt, you may take the quiz a second time. Because the questions are chosen randomly, you may receive different questions on your second attempt, so it is a good idea to review the pre-lab session prior to your second attempt. You may also view the laboratory session while you are taking the prelaboratory quiz. If you fail to pass the quiz on a second attempt, review the laboratory material again and be prepared to take another prelaboratory quiz at the beginning of laboratory class given by your TA.

b***. Pre-lab quizzes are timed quizzes.*** You have twenty minutes to take the quiz. Furthermore, once you open a window to take a quiz, it will be counted as one of your two attempts ***even if you do not hit the submit***

button before closing the window. ***Only start the pre-lab quiz when you are ready to take it.***

c. In order to receive your 2 points for the prelaboratory quiz you must complete it successfully at least *1 hour* before your laboratory class is to begin.



4. Completing the Post-Laboratory Exercises.

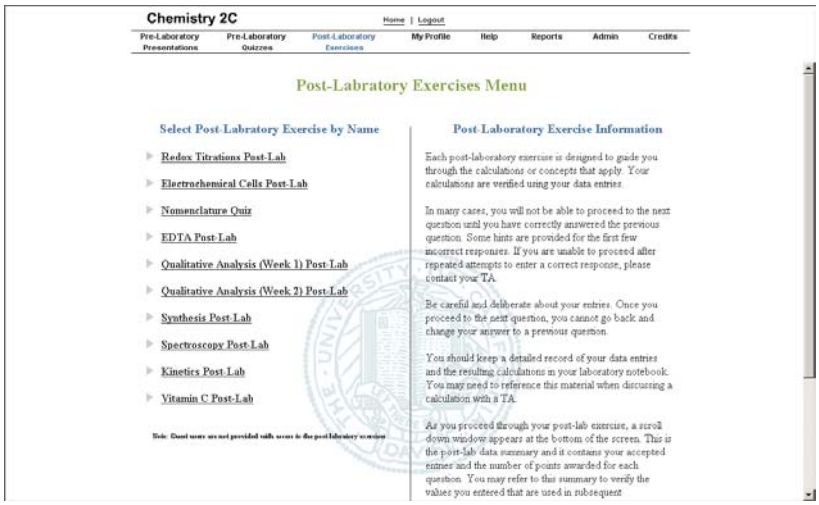
You will need to complete all the on-line post-laboratory exercises for each lab in order to receive credit for the laboratory portion of the course.

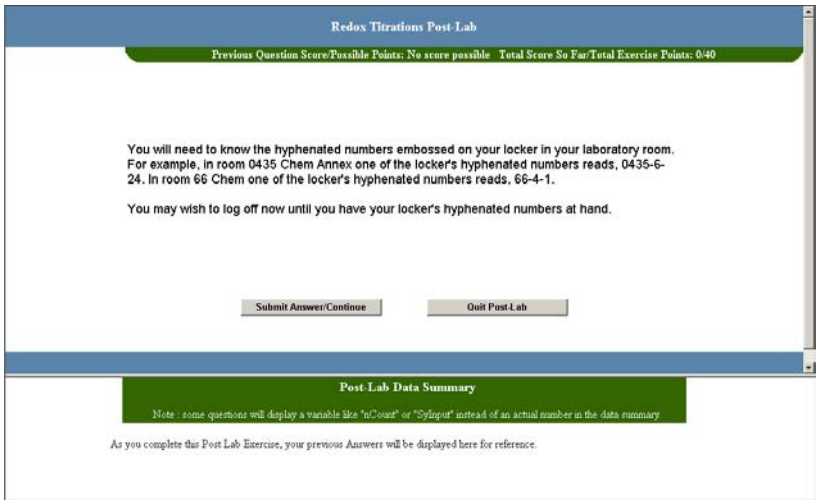
In the post-laboratory exercises, you will be asked to enter your data and the results from your calculations. For your data entries, the post-lab exercises are designed to check that your data is sensible. For example, if you are asked to weigh approximately 3 g of a substance, the program will check to see if your data entry falls within a range such as 1 - 6 grams.

For your calculation entries, the program is designed to verify that your calculation is correct based on your previously entered data. The program also allows for rounding differences. For example, if the program is expecting the entry, 0.234, based on your data, then a value in a range of 0.232 – 0.236 may be accepted.

There are also multiple-choice questions and free response questions posed in the post-lab exercises. An on-line text box will be provided for you to write any concluding remarks discussing and explaining your experimental results.

a. Click on post-laboratory exercises. Choose the appropriate laboratory exercise and follow the instructions. See below.





b. You will need to have your laboratory notebook and a calculator or spreadsheet program to complete the exercises. You should keep a detailed record of your data entries and the resulting calculations in your laboratory notebook. You may need to reference this material when discussing a calculation with a TA.

c. As you proceed through your post-lab exercise, a scroll down window appears at the bottom of the screen. This summary is the post-lab data summary, and it contains your accepted entries and the number of points awarded for each question. You may refer to this summary to verify the values you entered that are used in subsequent calculations.

d. When asked to collect data for multiple trials, you must have data for at least 3 trials to complete the post-lab exercises. The single exception to this is Part III of the Vitamin C laboratory. When entering data or calculated values, do not include unit symbols

e. In many cases, you will not be able to proceed to the next question until you have correctly answered the previous question. Some hints are provided for the first few incorrect responses. If you are unable to proceed after repeated attempts to enter a correct response, please contact your TA.

f. Be careful and deliberate about your entries. Once you proceed to the next question, you cannot go back and change your answer to a previous question.

g. In contrast to the pre-lab quizzes, you may exit the post-laboratory exercise at any time and re-enter as many times as you wish. Upon re-entry, the program will begin with the same question that you were answering when you exited. Points are not awarded until you click the submit button.

Scoring Scheme

h. The first line of text on each question contains a terse notation describing the scoring for that question. The notation used and an explanation of each is provided below:

1. Data Entry – No Scoring

   Simply enter your experimental value. The program will verify that your entry is within the expected range for the experiment, but no awarding of points is involved.

2. Scoring Scheme: 2–1

   These are typically questions that have only two alternative answers. If you select the correct answer, you will receive two points. If you select the incorrect answer, you will receive one point for completing the question and you will be informed of the correct answer.

3. Scoring Scheme: 3-2-1-1

   These are typically multiple-choice questions with three alternatives. If you select the correct answer on the first try, you will receive three points. The possible points earned are then reduced by one point on each try and a hint is provided. You will receive a minimum of one point if you answer correctly on the third or subsequent tries.

4. Scoring Scheme: 3-3-2-1

These are typically questions that require you to do calculations based upon previously entered experimental data, but may also be multiple choice questions with 4 or more alternatives. If you respond correctly on either of the first two tries, you will receive three points. The possible score is reduced by one point for each of the next two tries and remains one point for a correct response on any subsequent try.

5. Free Response (1 or 2 points possible)

Some of the laboratories contain questions where you will write your answer in a text box. The point value for each question will be indicated. Your TA will read your responses and award you your points accordingly. Your points for these questions will appear in your on-line score sheet.

6. Analysis (1 to 5 points possible)

In some of the laboratories, you will analyze a sample of unknown content. In the Redox and EDTA laboratories you will find a mass percent and in the Qualitative Analysis laboratory you will be identifying the metal ions present in a mixture. In these three laboratories, you will be awarded 1 to 5 points for accuracy. In order for the on-line program to identify which sample you were assigned to analyze, you will need to enter your locker series number.

Due Date/ Late Submission of Post-lab Exercise.

The post-laboratory exercises must be completed by the next normally scheduled laboratory meeting. The last post-laboratory exercise is due ***the last day of instruction***. Each post lab exercise has a date/time stamp to indicate the date and time of completion. ***Late submission of your post lab exercise will be met with a 5-point deduction for every calendar day it is late.***

NOTE: If you run into difficulty with any of your post-laboratory entries, please contact your TA.

C) Late Reports & Make-Up Policy

1. Late Reports

Laboratory reports are due at the beginning of the period after the one allocated for the completion of the experiment. The last report each quarter is due at the

time indicated by the TA. ***Late reports will be met with a 5-point deduction for every calendar day the report is late.***

2. Laboratory Make-Up Policy

Students must attend the laboratory class for the section in which they are enrolled. If a student misses a laboratory class, ***it must be made up before the end of the following week of laboratory***. See the schedule below for exceptions to this policy. No further opportunity for make-up will be provided to the student who fails to make up the lab by the following week. ***If a student misses the last lab of the quarter, it must be made up immediately.*** Typically, laboratory classes end one or two days before the end of the quarter. ***No laboratory make-ups will be offered after the last day of laboratory.*** Students who have missed making up the lab within the allotted time period but can present proof of an extended illness or family emergency must contact the head teaching assistant as soon a possible to make arrangements regarding the missed labs. If you cannot present this proof, you may receive a failing grade in the course.

3. Laboratory Make-up Procedure

You are required to complete all labs in order to pass the course and it is your responsibility to make up any missed labs promptly. Failure to make up a lab may result in a ***failing grade*** for the course.

If you miss a lab, you must make it up by attending another scheduled laboratory section. Consult the Class Schedule and Room Directory for a listing of rooms and times. Go to the selected laboratory section and ask the teaching assistant if you may be admitted to make up a lab. You must be on time for the start of the lab period. If there is room in the class, the teaching assistant will allow you in the lab, unlock your locker, and allow you to do the lab. Make sure to record the ***teaching assistant's name, date, time and room number where you made up the laboratory.*** Have the TA collect your data sheet and he or she will give it to your regularly assigned teaching assistant. ***No laboratory report will be accepted without a valid copy of the data sheet.***

4. Plagiarism and Unauthorized Collaboration

Some of your experiments will be done with lab partners. You are encouraged to discuss your data and its analysis and interpretation with your lab partner, other students and the TAs. However, the actual data analyses and the written reports ***must*** be done entirely independently of your lab partner or other students. Make sure that you avoid unauthorized collaboration and plagiarism. All suspected violations of the Code of Academic Conduct will be referred to Student Judicial Affairs.

D) Common Laboratory Procedures

1. Using the Balance

A balance is used to measure the mass of an object. Each laboratory room contains two electronic balances that are very easy to use. A diagram of a balance is shown in Figure 1. To use the balance, turn it on by pushing the tare bar down. The electronic readout should then be lit. Open one of the sliding doors and be sure the balance pan and surrounding area is clean. You can clean it with a balance brush or Kimwipe. Next shut the doors and press the tare bar to set the balance at zero. Now simply place the object to be weighed on the balance and measure the mass to 0.001 grams.

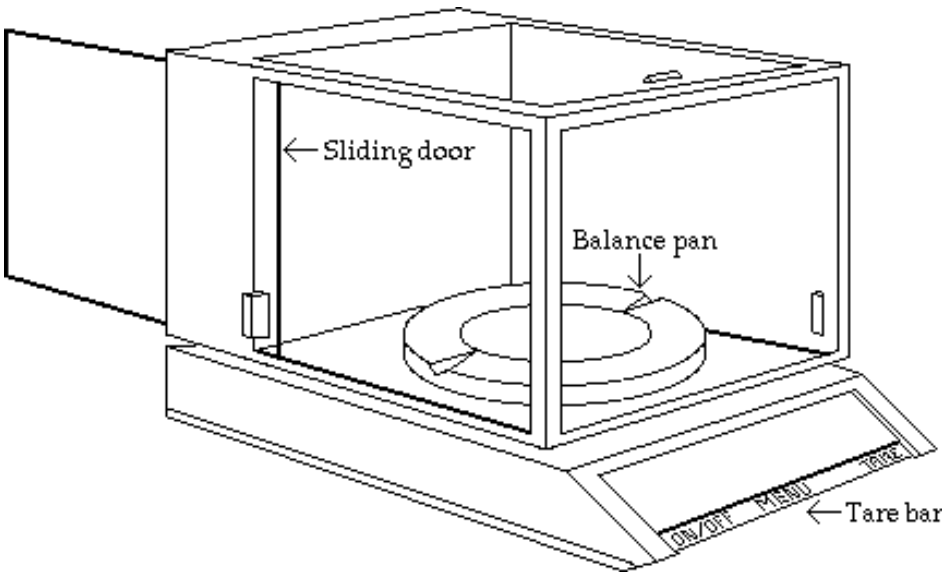
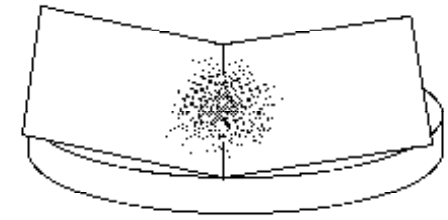


Figure 1: The Balance

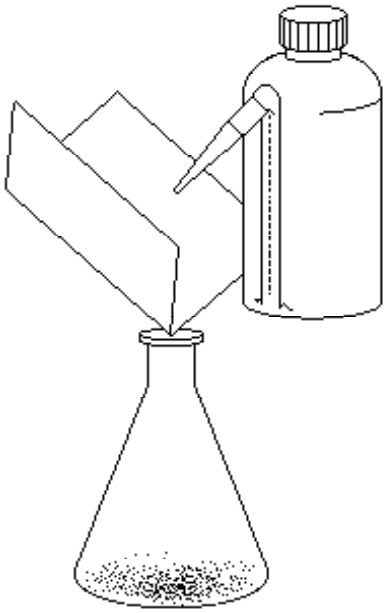
Always use weighing paper when weighing solids to protect the balance. To do this simply place the weighing paper on the balance pan and be sure it is not touching the side. Press the tare bar on the right side and the balance will then read 0.000 g. Now add the desired mass of solid and record the mass. Always clean the balance carefully after use. At the end of the period,, turn off the balance by raising the tare bar. ***Always use the balance with extreme care as it is very expensive.***

2. Handling Solids

Use a ***clean*** spatula to transfer solid from bottles. Never use a contaminated spatula. Also, never return unused solid to the reagent bottle. Simply discard it. To avoid waste, never remove more solid from a bottle than is necessary. Below in Figure 2 is an illustration of how to properly weigh and transfer a solid using weighing paper. In the Chemistry 2 laboratories we are presently using weighing boats rather than weighing paper, however the techniques shown in the Figure are still useful and should be carefully examined.



Fold a weighing paper in half and tare it. Weigh out the solid and record the mass.



Pour the solid into the flask. Using a water bottle, wash the remaining solid on the paper into the flask.

Figure 2: Solid Transfer

3. Handling Liquids

When transferring liquids from a reagent bottle, always remove the cap/stopper and hold it in your hand. Never place the cap/stopper on the bench or contamination could result. Pour the liquid slowly and carefully to avoid spillage. You may find the use of a glass rod helpful, as is shown below in Figure 3.

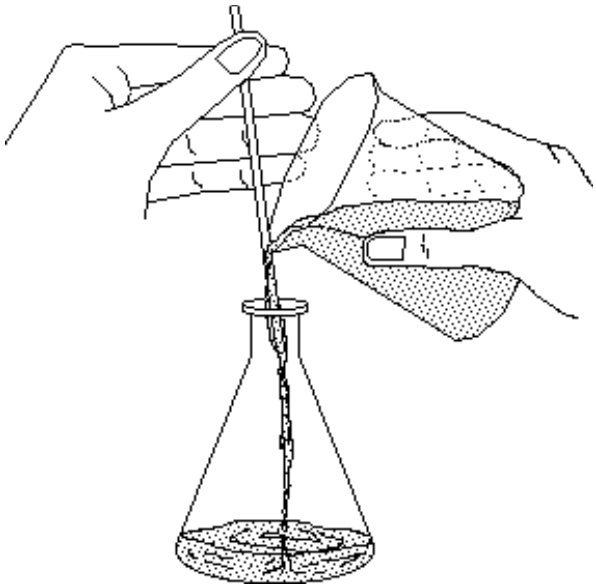


Figure 3: Liquid Transfer

4. Capping a Flask

During many experiments you will have to cap a flask to protect the contents from contamination. Figure 4 illustrates the proper method using Parafilm.

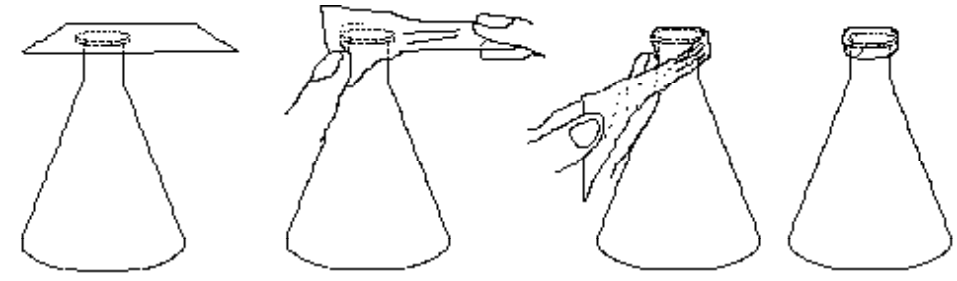


Figure 4: Capping a Flask

5. Measuring Liquid Volumes

Many glassware items have volume marks printed on them. Before using a piece of glassware to make a volume measurement, you should take a moment to study its calibrations to insure that you know how to read them properly. A beaker or Erlenmeyer flask can be used for rather rough measurements. A graduated cylinder of the appropriate size can be used for measurements of moderate accuracy. A pipet is commonly used to transfer an accurately known volume of a liquid from one container to another. However, the accuracy of such a transfer is only as good as the technique of the operator will allow.

In making any volume measurement, the liquid level should always be the same as your eye level. Erlenmeyer flasks and graduated cylinders are usually filled/read by raising them to your eye rather than by squatting down to bring your eye level to the bench top. The liquid level in a pipet is always lowered to the mark while the mark is held steady at eye level.

Burets: With practice, the position of the meniscus of a liquid in the 25 mL burets used in the Chemistry 2 labs can be estimated to within 0.02 mL. Figure 5 shows the use of a card with a dark strip on it to sharpen the image of the meniscus. You will find by experiment that if the top of the strip is positioned slightly below the level of the liquid in the buret, the bottom of the meniscus will be very easy to see.

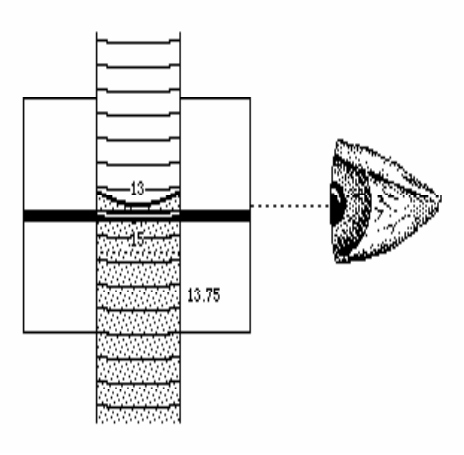


Figure 5: Reading the Meniscus

You should always use the following procedure when changing the solution in a buret. First, empty the buret out the top and half-fill it with deionized water. Open the stopcock and drain about 5 mL out of the tip. Over the sink, empty the buret out the top by inverting it swiftly, and then repeat the water washing, this time also opening the stopcock when the buret is inverted to allow most of the water to drain back out of the tip. Wait about 30 seconds for drainage and then close the stopcock. While it is still upside down, blot/wipe off the top of the buret with a laboratory tissue. Then turn it upright, and using a clean, dry beaker for the transfer, add enough of the new solution to bring the liquid level up to about the 48 mL mark. Next, drain part of the liquid out of the tip into a waste receiver, close the stopcock, and wipe off the tip with a laboratory tissue. Then, at the sink, cradle the top of the buret between the thumb and index finger of one hand. While holding it by the tip with your other hand, turn the buret horizontal. While twirling the buret by the tip, slowly empty it through the top, being careful to wet the entire interior wall with the new solution. Repeat this operation two more times. Finally, fill the buret above the zero mark and drain the excess out the tip until the meniscus is within the calibrated portion of the buret. Be sure that no air

bubbles are trapped in the tip. Do not attempt to bring the meniscus to 0.00. This method is both time consuming and unwise, since the 0.00 line may not be in precisely the right place.

Pipets: Students often experience some initial difficulty in using a pipet. The following instructions, the illustrations in Figure 6 and some hands-on practice using deionized water should help you to become proficient fairly quickly. In what follows, we assume that the pipet has been pre-rinsed with the solution you want to transfer following essentially the same procedure as that described above for burets, except that you must use a bulb to suck the small doses of water or the new liquid into the pipet rather than pouring them in from a beaker.

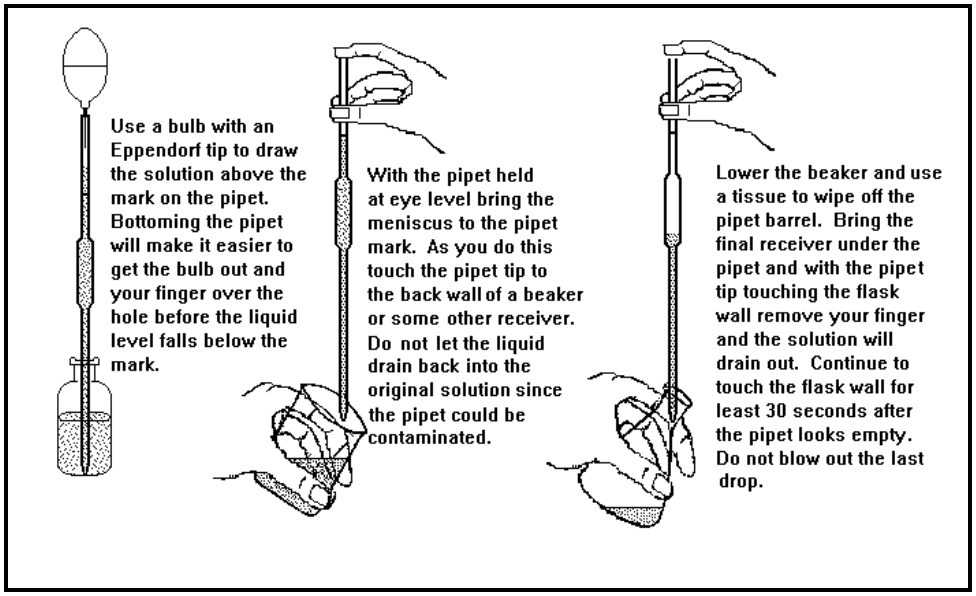


Figure 6: Using a Pipet

To begin a pipetting operation hold the pipet vertical and rest the pointed end on the bottom of the container from which you want to transfer a sample. With your least-dexterous hand, use a rubber bulb fitted with an Eppendorf tip to draw the liquid a few centimeters above the mark on the pipet. If you keep the pipet bottomed, you can then remove the bulb and quickly seal the pipet mouth with the index finger of your "better" hand before the liquid level falls below the mark. You might try conditioning your index fingertip first by rubbing it gently in the palm of the other hand. If your finger is too wet, you can't create a small enough crack (see below), and if it is too dry, you can't get a good seal.

Raise the over filled pipet vertically out of the vessel from which you are taking the measured sample and quickly put a beaker or some other waste receiver under it. Raise the mark on the pipet to your eye level, tilt the receiver slightly, and touch the pointed tip of the pipet to a dry spot on its sidewall.

If you now slightly rock your index finger you can open and close a tiny crack at the mouth of the pipet and thereby allow the liquid level in the pipet to fall exactly to the mark on its shaft. (In this step some individuals have more success by slowly rotating the pipet using the thumb and the other fingers on the hand

holding it.) Be patient because if you overshoot the mark you must begin the whole process again.

Remove the accurately filled pipet from its container and while still tightly sealing its top with your finger, quickly dry the lower portion of the shaft with a single downward stroke of a laboratory tissue. Tilt the final receiver slightly and while holding the pipet vertical, place its tip against the receiver wall so that when take your finger off of the pipet mouth, liquid will flow smoothly down to the bottom of the vessel. You want to avoid splashing as much as possible. Keep the tip of the pipet in contact with the flask sidewall for at least 30 seconds after it looks empty, and then remove it from the receiver.

The pipets in the Chemistry 2 laboratories are calibrated "to deliver" the specified quantity of liquid rather than "to contain" it. What this really means is that you should never blow the last drops out of them.

6. Filtration

You will often need to separate a liquid from a solid. At times you will simply decant, that is, you will carefully pour out the liquid, leaving the solid behind. At other times you will need to filter the solution. To do this you will use filter paper and a funnel. You must first flute the paper in order to accelerate the process; this is shown in Figure 7.

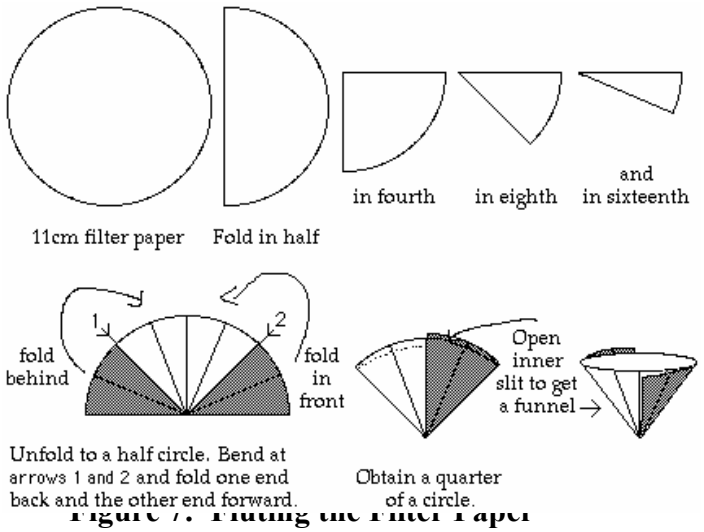


Figure 7: Fluting the Filter Paper

You will then set the paper in the funnel using your wash bottle. To do this simply place the paper into the funnel and add a small amount of water to the bottom of the filter. Slowly add water to the sides with a circular motion to avoid air bubbles between the paper and the funnel. Once the paper has set, transfer the solution to be filtered. If the solid has settled, decant the liquid through the filter first in order to save time. Never overwhelm the filter; don't add the solution too quickly and never come to within one centimeter of the top of the paper. Transfer the solid using a wash bottle and rubber policeman, and then wash the solid as directed by the experimental procedure.

7. Heating

You will use both a hot plate and a Bunsen burner to heat solids and solutions. Always be careful to avoid burns and never heat a material too quickly or explosive "bumping" can occur. When using a hot plate always begin at the setting indicated in the manual. However, this setting may vary depending on the hot plate so you will have to experiment. In using a Bunsen burner, always use a

tight blue flame as shown in Figure 8. Control the heat transfer by adjusting the distance from the burner to the object. Note that the distances suggested in the manual are measured from the hottest part of the flame to the object.

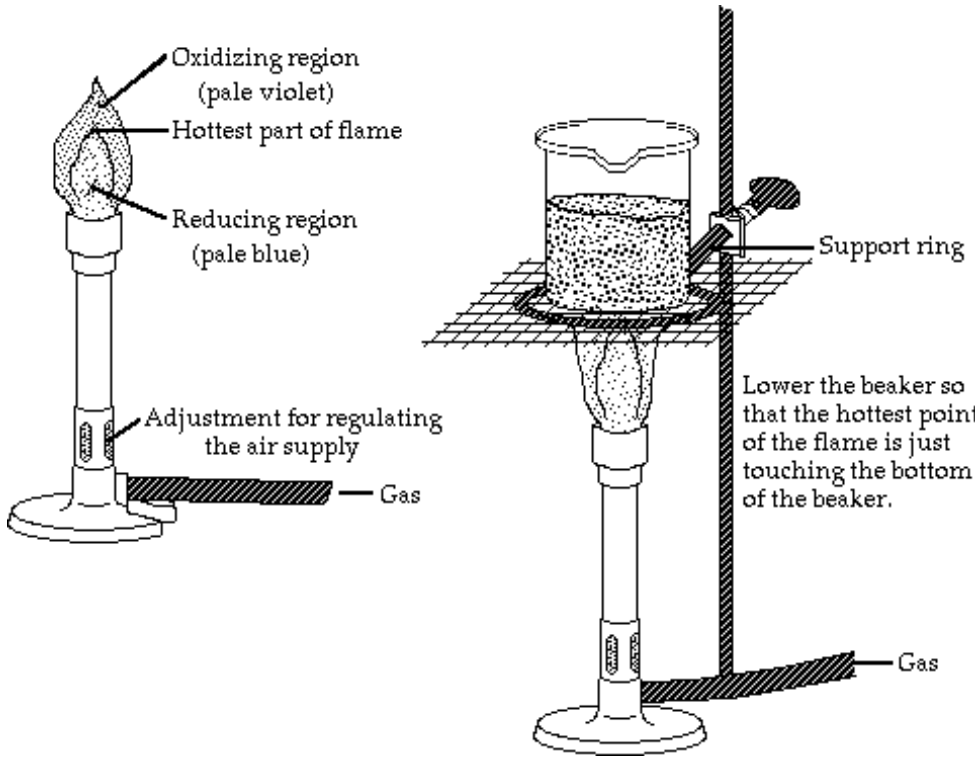
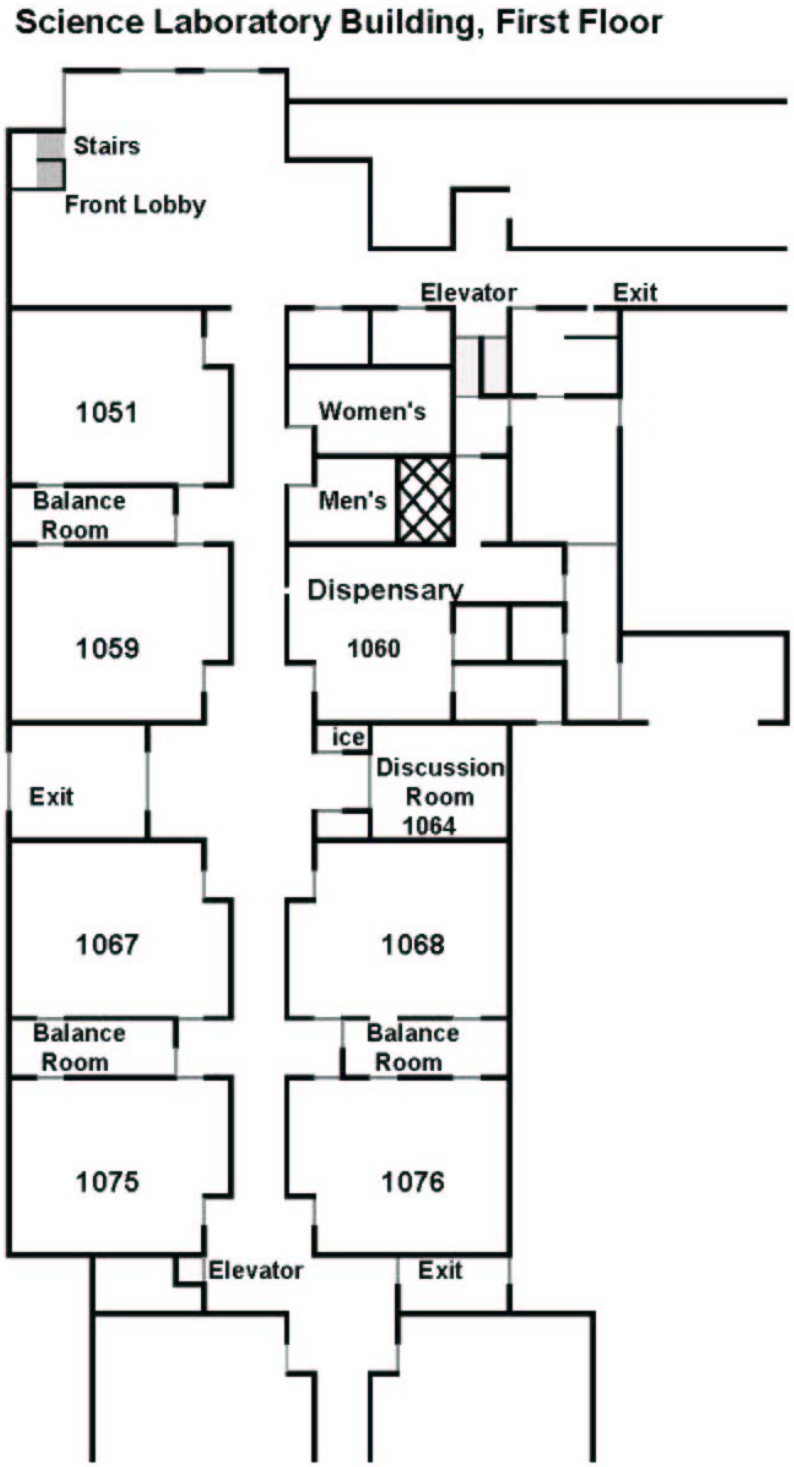


Figure 8: The Bunsen Burner

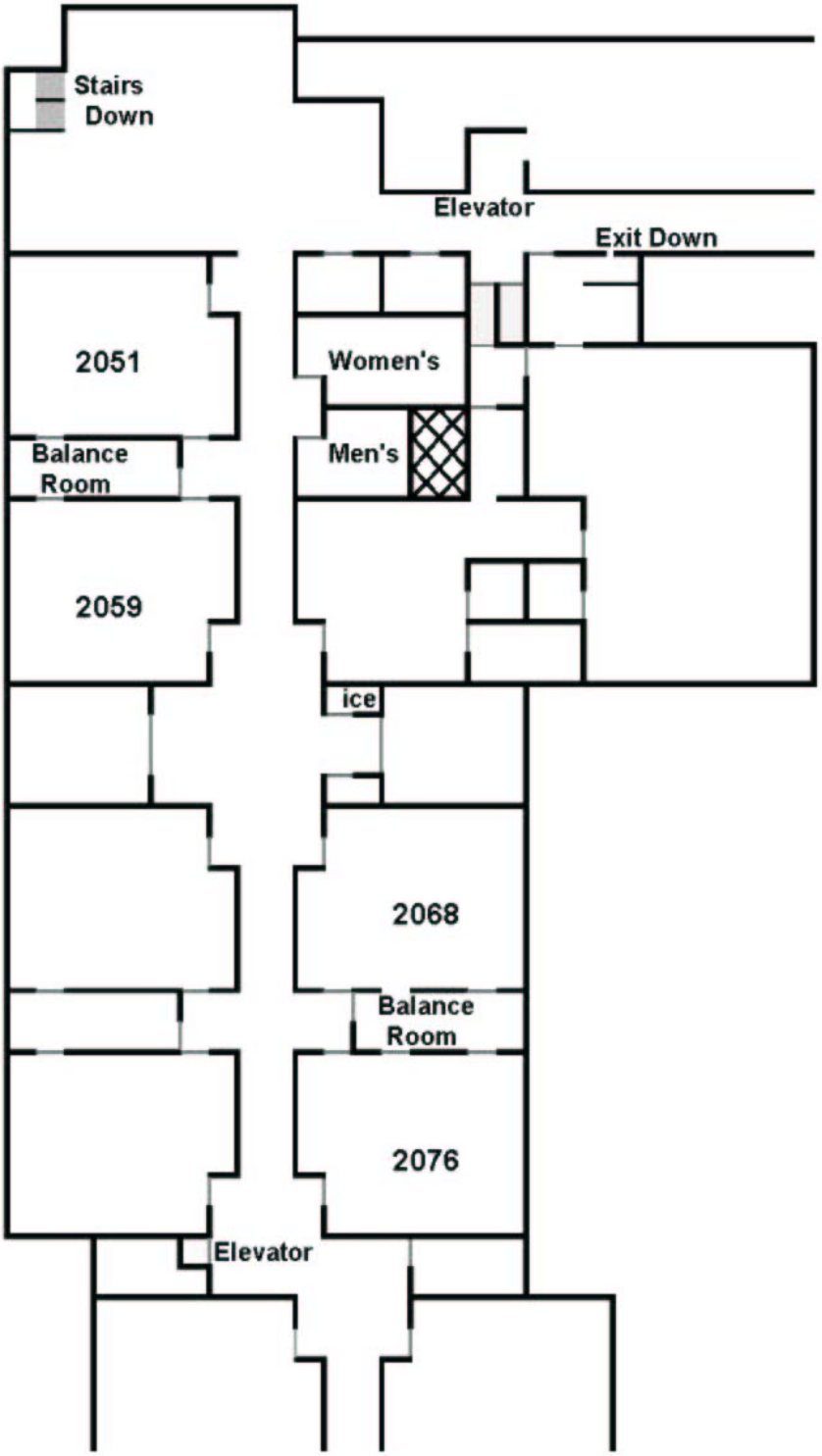
8. Barometric Readings and Unit Conversions

There are barometers placed in each laboratory room that give the barometric pressure readings in inches of Hg. This measurement must be converted to mmHg. The conversion factor is 1.00 inch = 25.4 mm.

E) Maps


Science Laboratory Building, First Floor
Stairs
Front Lobby
Elevator
Exit
1051
Women's
Balance Room
Men's
Dispensary
1059
1060
ice
Discussion Room 1064
Exit
1067
1068
Balance Room
Balance Room
1075
1076
Elevator
Exit

Science Laboratory Building, Second Floor



F) Dispensary Procedures

1. Dispensing Policies

The following outline concisely describes the various stockroom dispensary procedures that will be used this quarter. Please read this over carefully, and discuss any questions you may have with your TA.

a. Policies at Beginning of Quarter

Goggles You must use the approved goggles given to you in Chemistry 2A. If you have lost those goggles, it is your responsibility to replace them before the lab starts.

Locker Supplies There will be a two-week grace period for filling out dispensing room slips when checking out supplies from the dispensary for your locker. Make sure that you have everything on your locker list by the end of the second week of instruction.

b. Policies During the Quarter

Locker Supplies If a locker item is broken after the initial two-week period, you must bring the broken item or a representative portion thereof to the dispensary and fill out a dispensing slip for a replacement. If for some reason you are not able to bring the broken item, you must fill out a dispensing room slip and have your TA sign it before you may obtain a replacement.

Equipment on Loan from the Dispensary All equipment that is on loan from the dispensary must be returned to the dispensary at the end of each laboratory period.

Refilling of Chemical and Supply Containers When replacing or refilling general laboratory chemicals or supplies, be sure to bring the empty containers to the dispensary. In the case of chemical containers, be sure to return the tops or caps with the containers.

Waste Containers Full waste containers may be exchanged for empties located below the fume hoods. Additional containers may also be obtained from the dispensary.

c. Policies at the End of the Quarter

Surplus Stores Any item you may have in surplus should be placed in the area set aside for surplus items in the laboratory (a box at the back of the lab).

Filling Locker Requirements If your locker is short of any items when you are checking your locker equipment against your locker list, obtain the missing items from the surplus items in the laboratory. If the missing item is not in the surplus area, obtain it from the dispensary.

Preparing Your Locker for Check-In Clean and dry all equipment. Replace all broken or missing items by checking them out from the stockroom. Return all extra equipment to the extra glassware box in the lab. Have your TA check the contents of the locker and if everything is present and clean then they will lock the drawer.

2. Waste Labels

Chem 2 Experiments

Cation Metal Waste

Chemical Waste Composition:

Bismuth, Chromium, Cobalts, Copper, Lead Manganese, Silver, Zinc

WASTE

Label is WHITE and is used in all Chem 2 courses.

Chem 2C Experiment Qualitative Analysis

Chemical Waste Composition:

Chloroform, Dithizone, Acetone

WASTE ONLY

Label is BLUE and is used only in Chem 2B

Chem 2B Experiment
Colligative Properties

Chemical Waste Composition:

Cyclohexane, Acetone, p-Dibromobeneze, p-Dichlorobenzene, Naphthalene, Diphenyl, Benzophenone,

WASTE ONLY

Label is YELLOW and is used only in Chem 2B

3. Locker Inventory

Procedure for beginning of quarter

(1) Replace broken or missing items in your locker in the first two weeks. They may be checked out from the stockroom (Room 1060). All excess equipment should be placed in the extra glassware box (red) in the lab room.

(2) One pair of SAFETY GOGGLES will be supplied to each **Chem 2A** student. They must be worn AT ALL TIMES when in the laboratory, including during locker check out. Only safety goggles which have been approved by the Chemistry Department are acceptable

CHEMISTRY 2 LOCKER LIST

GLASSWARE

- 1 100 ml Beaker
- 1 150 ml Beaker
- 1 250 ml Beaker
- 1 400 ml Beaker
- 1 800 ml Beaker
- 1 50 ml Erlenmeyer Flask
- 2 125 ml Erlenmeyer Flask
- 2 250 *or* 300 ml Erlenmeyer Flask
- 2 500 ml Erlenmeyer Flask
- 1 100mm Watch Glass
- 2 Glass Stir Rod
- 10 Test Tubes (rounded end)
- 6 Centrifuge Tubes (pointed end)
- 2 Thermometer, non-mercury
- 2 25 ml Volumetric Flask
- 1 250 ml Volumetric Flask
- 1 5 ml Volumetric Pipet
- 1 10 ml Volumetric Pipet

METAL EQUIPMENT

- 1 Beaker Tongs
- 1 Crucible Tongs
- 1 Scoopula
- 1 Test Tube Clamp

PORCELAIN

- 1 Small Casserole
- 1 Large Casserole
- 1 Evaporating Dish
- 2 Crucible
- 2 Crucible Cover

PLASTIC WARE

- 1 250 ml Washing Bottle
- 1 25 ml Graduated Cylinder (may be glass)
- 1 Short Stem Funnel (may be glass)
- 2 1 L Bottle, square
- 1 Desiccator
- 1 Pipet bulb w/ Tip
- 1 Plastic Test Tube Rack

OTHER

- 1 Centrifuge Tube Brush (pointed end)
- 1 Test Tube Brush (rounded end)
- 2 Match Books
- 1 Vial, Alkacid Test Paper
- 1 Sponge
- 2 Rubber Policeman
- 1 Wire Triangle, Pipe Stem Covered
- 1 Wire Gauze Square

COMMUNITY SUPPLIES

COMMUNITY LOCKERS

- 8" Extension Clamp
- Clamp Holder
- Small Support Ring
- Large Support Ring

SHELVES

- 50 ml Buret

AT LAB BENCH

- Bunsen Burner
- w/ Silicone Rubber Tubing

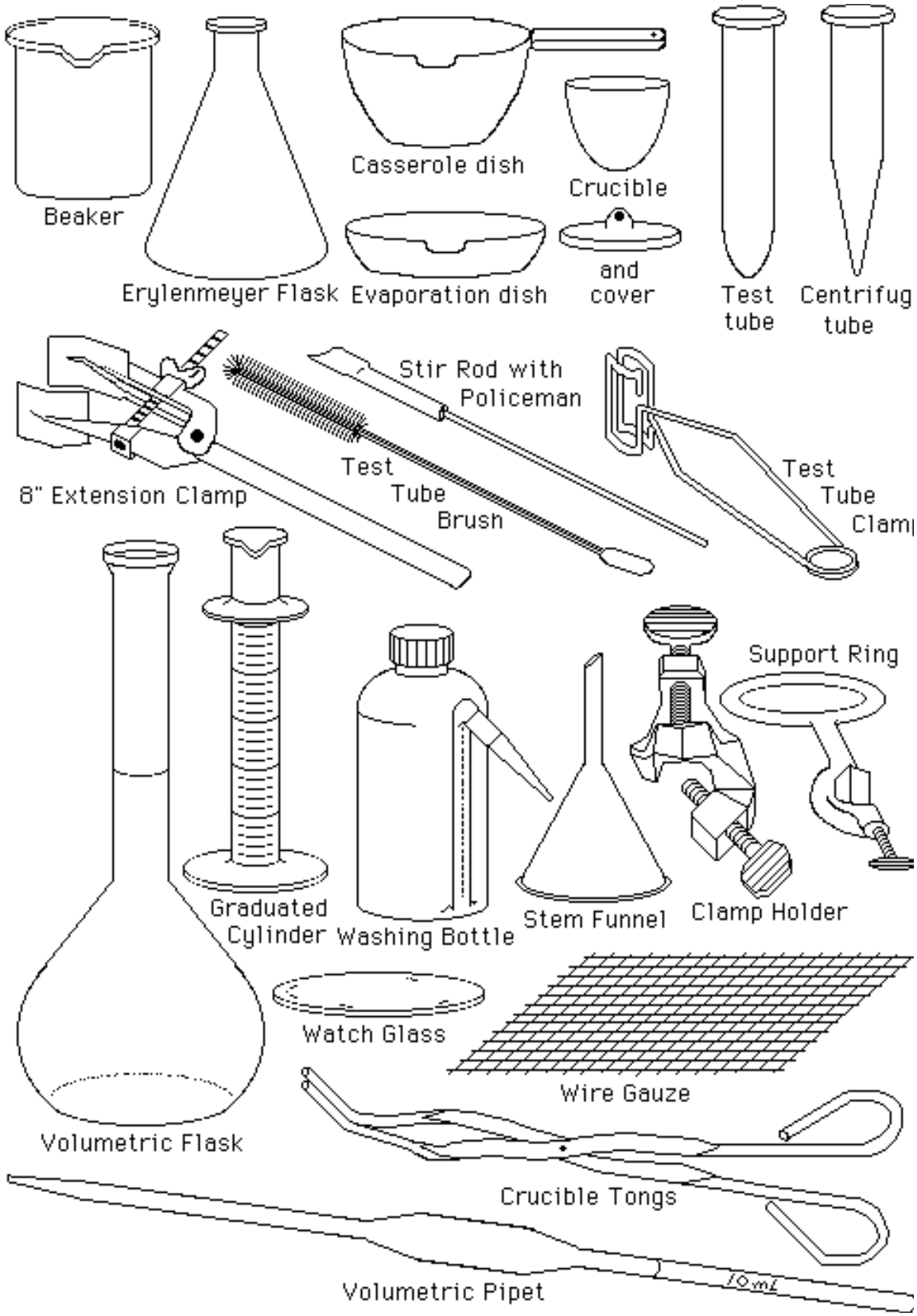
Procedure for end of Quarter

(1) Clean and dry all equipment.

(2) Replace all broken or missing items by checking them out from the stockroom. Return all extra equipment to the extra glassware box in lab.

(3) Have your TA check your equipment and initial below.

Student Name _____ T.A. _____
(print) (initial)


Beaker
Erylenmeyer Flask
Casserole dish
Crucible
and cover
Evaporation dish
Test tube
Centrifug tube
8" Extension Clamp
Test Tube Brush
Stir Rod with Policeman
Test Tube Clamp
Graduated Cylinder
Washing Bottle
Stem Funnel
Support Ring
Clamp Holder
Watch Glass
Wire Gauze
Volumetric Flask
Crucible Tongs
Volumetric Pipet
10 ml

Periodic Table of the Elements

1 IA																	18 VIIIA
1 **H** 1.008	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.64	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	71 **Lu** 175.0	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	103 **Lr** (262)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (269)	109 **Mt** (268)	110 **Uun** (271)	111 **Uuu** (272)	112 **Uub** (277)		114 **Uuq** (289)				

57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0
89 **Ac** (227)	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)