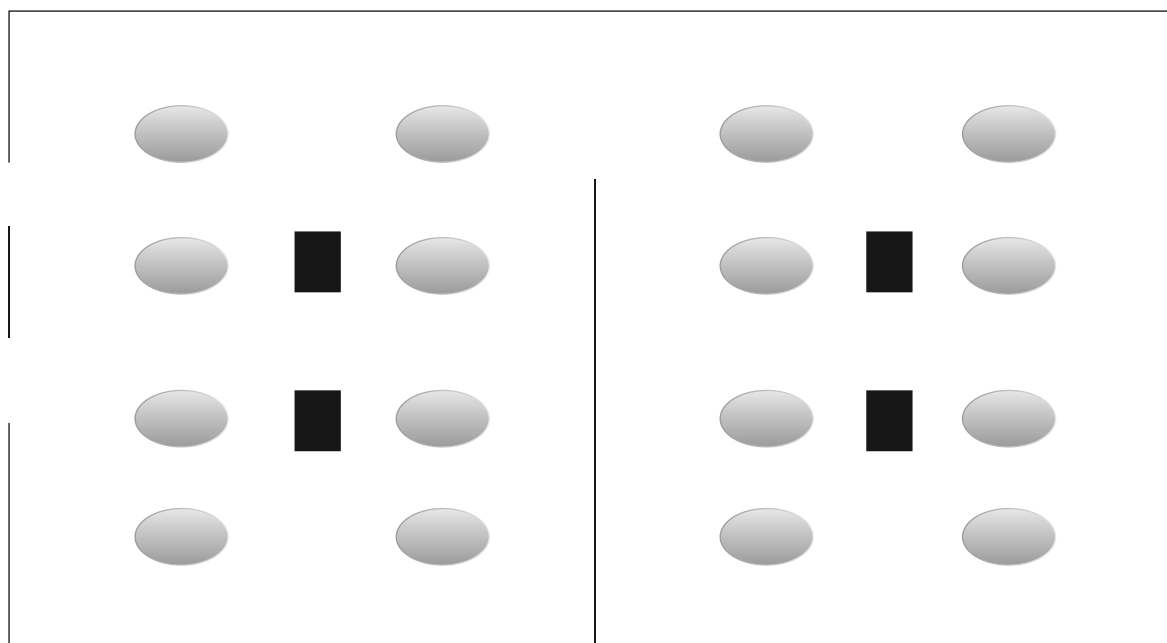


# Chem Annex Lab Room Safety Device Scavenger Hunt

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Before you begin laboratory work, you must be familiar with the location of the safety devices in and near your laboratory room. On the diagram below, mark the location of safety devices in your room. Indicate the location of your assigned work space using an asterisk (\*).

Quantity	Device/Item	Symbol
	eye-wash station	×
	safety shower	○
	dispensing station	■
	first aid box	+
	fume hood	△
	room exits	→
	fire extinguishers	•
	chemical spill kit	□
	broken glass box	⊗



# Introduction to Chemistry 103

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# Read This First!

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We have a good deal of material on the course website. Before reading this lab book, visit the website and become familiar with it.

Most importantly, find your one-page summary of due dates for all assignments throughout the semester. To do this:

- Go to [www.chemistry.illinois.edu/clc](http://www.chemistry.illinois.edu/clc)
- Choose “Course Web Sites”
- Choose “Chemistry 103”
- Click on “Lab Schedule”
- Click on the day of your lab section. The one-page summary will look similar to the tables you will find on the next page of this lab book but it includes your specific due dates for your lab section. It is a good idea to print out the schedule—the due dates are set and **late assignments will NOT be accepted**.

Read through the material given on the course webpage. You will find general information, such as contact information of the course instructor and TAs, course material list, and links to LON-CAPA online assignments and the ATLAS grade book. Click on “LON-CAPA Homework” and make sure you can sign in.

You will find a Lab Safety Video and Lab Safety Quiz on LON-CAPA. You must watch this video and successfully **complete** the safety quiz before you will be allowed to attend your first experiment. You will also need to **complete** the PreLab 0 quiz. If you fail to complete the quizzes, you will not be allowed into the lab room. If you fail to complete the Lab Safety Quiz after three experiments, you fail the course.

For this class you will need the following:

- Lab manual (this book)
- Lab notebook (Notebook pages are included at the end of this manual, see the section *Laboratory Notebooks* under Course Policies on how to prepare your notebook before coming to lab.)
- Bring goggles (required goggles: *Honeywell Uvex Stealth OTG safety goggles*) and a lab coat.
- Wear the proper attire. See the safety quiz on LON-CAPA—you must complete this quiz by 10:00 pm the evening before Experiment 1. The safety policies are also provided for you in this lab manual.
- Complete the *PreLab* assignment #1 by 10:00 pm the evening before your lab. This includes *PreLab #0*.

## CHEMISTRY 103, SPRING 2018

## Experiment Dates

Experiment	Date
Mandatory Check-In/Lab Orientation for all 103 students	Week of January 22
Lab 1: The Density of Water and Data Analysis	Week of January 29
Lab 2: Determining the Composition of a Salt Solution	Week of February 5
Lab 3: Beer's Law and Food Dyes	Week of February 12
Lab 4: Spect. Analysis of Lemon-Lime Kool-Aid	Week of February 19
Lab 5: The Stoichiometry of Baking Soda	Week of February 26
Lab 6: Det. the Molar Mass of an Unknown Compound	Week of March 5
Lab 7: Calorimetry and Enthalpy of Dissolving	Week of March 12
Spring Break	Week of March 19
Lab 8: Using Calorimetry to Measure Changes of State	Week of March 26
Lab 9: Hess's Law	Week of April 2
Lab 10: LeChâtelier's Principle	Week of April 9
Lab 11: Det. the Value of an Eq. Constant for a Chemical Rxn.	Week of April 16
Lab 12: Determination of a Solubility Product, $K_{sp}$	Week of April 23

## PreLab Dates

All due by 10:00 pm on LON-CAPA

PreLab HW For:	Due Week Of
Lab 1 (Density)	January 28
Lab 2 (Salt Soln)	February 4
Lab 3 (Beer's Law)	February 11
Lab 4 (Kool-Aid)	February 18
Lab 5 (Stoichiometry)	February 25
Lab 6 (Unk. Compound)	March 4
Lab 7 (Calorimetry Diss.)	March 11
Lab 8 (Calorimetry State)	March 25
Lab 9 (Hess's Law)	April 1
Lab 10 (LeChâtelier)	April 8
Lab 11 (Eq. Constant)	April 15
Lab 12 (Solubility)	April 22

## PostLab Dates

All due by 5:00 pm on LON-CAPA

PostLab HW For:	Due Week Of
Lab 1 (Density)	February 4
Lab 2 (Salt Soln)	February 11
Lab 3 (Beer's Law)	February 18
Lab 4 (Kool-Aid)	February 25
Lab 5 (Stoichiometry)	March 4
Lab 6 (Unk. Compound)	March 11
Lab 7 (Calorimetry Diss.)	March 25
Lab 8 (Calorimetry State)	April 1
Lab 9 (Hess's Law)	April 8
Lab 10 (LeChâtelier)	April 15
Lab 11 (Eq. Constant)	April 22
Lab 12 (Solubility)	April 29

# Preface

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**Welcome to Chemistry 103!** This course is an introduction to the chemistry laboratory at the college level. You will complete twelve chemistry experiments in the laboratory designed to help you better understand the chemistry you are learning or have learned in Chemistry 102 or a similar course. You will do some deducing as you determine the identity, composition, or qualities of several systems or chemicals.

This manual is designed to help you on your way in Chemistry 103. Its aim is to guide you through the experiments you will undertake and help introduce you to several topics, techniques, and principles of chemistry. The experiments are intended to introduce you to laboratory work and it is our hope that you will find these laboratory experiences challenging and interesting.

Finally, we understand that our students are coming to us with different levels of experience in the lab. The teaching staff and course director welcome your concerns and questions, whenever they arise throughout the semester.



# Chemistry 103 Course Policies

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You must read this section before coming to your first scheduled experiment.

## CHEMISTRY 103 ONLINE

It is extremely important for you to familiarize yourself with the Chemistry 103 website. From this website you can access your schedule, the online grade book, and the work you need to submit for the course.

We suggest you go to the website as soon as possible.

To access the course website, go to <http://www.chemistry.illinois.edu/clc> then go to “Course Web Sites” and then to “Chemistry 103”. You will need to do the first online assignment **before** the first experiment, so you might as well explore the rest of the site at the same time. Click on the following links and familiarize yourself with them:

**1. Contact Information.** This page provides you with the e-mail addresses of all of the Chem 103 TAs (along with the sections each teaches). The office, office hours, and contact information for the Chem 103 course director is also provided on this page.

**2. Lab Schedule.** This page provides you with the schedule for the semester for each section. The specific schedule depends on the day your lab meets. Go to your particular meeting time schedule and **print it out**. You will then have the schedule for the date each lab meets, along with due dates for all online assignments.

**3. LON-CAPA Homework.** This link allows you to access all online homework. You will have to complete a *PreLab* assignment before each lab, enter data during your lab session, and complete a *PostLab* assignment (which includes data analysis) after each lab. These assignments are described in more detail in *Required Components of the Course* (next) and the due dates for these are given in the Lab Schedule. Clicking on the LON-CAPA Homework link will bring you to the login page for LON-CAPA. Enter your NetID as your login and enter your password (this is your Active Directory password). The online assignments can be found by clicking the *Course Contents* button at the top of the page.

The Course Websites page has help in logging on to LON-CAPA. If there are additional problems, please contact your TA or the course director.

**4. Online Grade Book.** This link takes you to the Chemistry 103 grade book. This provides you with scores for all Chemistry 103 assignments. You will want to check this periodically throughout the semester to make sure the grades are entered correctly.



## REQUIRED COMPONENTS OF THE COURSE

**1. PreLab Assignments.** These assignments have been developed to make sure that you understand the concepts and the calculations involved in the lab experiments. These are found online via LON-CAPA and must be completed by 10:00 p.m. on the evening **before** the corresponding lab (see the online Lab Schedule for the specific dates). You will get immediate feedback concerning your answers, and before the deadline multiple attempts are allowed. By reading the lab manual and having perseverance, there is no reason to not earn all possible points for the *PreLab* assignments. Again, the point is to do this before the lab, so once the deadline has passed your access to the *PreLab* will be closed and will not be re-opened.

**2. Lab Assignments.** There are twelve labs throughout the semester (see the online Lab Schedule for specific times). Make sure to have your laboratory notebook prepared for data recording and analysis. See *The Laboratory Notebook* for information on preparing the notebook.

You are required to attend all laboratory periods. During the lab you will carry out the experiment, record your data in your laboratory notebook, and record your data in your LON-CAPA account. When you have completed the aforementioned tasks, you are expected to remain in the lab and complete as much of your post-lab as is possible with the remaining time. Students may only leave the laboratory early if their TA has verified that they have completed all of the post-lab questions.

You are not excused from the lab unless the reason falls under one of the categories described in *Attendance for the Course*. Two important points about missing the lab:

- Even if you are excused from a lab, you must still complete the online *PreLab* and *PostLab* assignments by their regularly scheduled due dates.
- Any student who misses more than three laboratory periods (excused or not) during the semester will automatically fail the course.

You may be familiar with LON-CAPA as a homework/quiz system. As such a system, LON-CAPA checks your answers and either provides you with immediate feedback, allowing you to change your answer (like the *PreLab* assignments), or accepts your answer and evaluates it after the due date, and credit is earned based on the correctness of your response (like the *PostLab* assignments). For data entry it is a bit different because LON-CAPA is not connected to a probe that gathers your data, so it has no way of knowing if what you enter is correct. You need to make sure you are entering the correct data as they will be used for subsequent calculations in the *PostLab*.

A few points about LON-CAPA data entry:

- **In the lab LON-CAPA accepts answers that may not be correct.** That is, you may make an error in the lab and get a poor result and LON-CAPA accepts it. This does not mean it is correct, even if accepted. In addition, you may measure a temperature as 25.2°C, for example, and enter it as 2.52°C. LON-CAPA will accept it because there is no way to know that you entered the value incorrectly. We sometimes put ranges of acceptable answers (for example, we may only accept temperatures between 0°C and 100°C for aqueous solutions). But do not think that just because data are accepted that they are correct. LON-CAPA does not know what you have measured and it is being used merely as data entry.

- **You cannot change data once you submit them.** Write your data in your tables in your laboratory notebook. Check to make sure what you have typed into LON-CAPA is correct and consistent with what is in your notebook before you hit the submit button. You may lose points on the PostLab because of poor data, even if it was accidentally entered. If your goal is to hurry to get out of lab, you will make a mistake. If your goal is to do it right, you will do it right, and you will still get out on time. We cannot change your data or clear your data once you submit it, so be careful.
- **Write everything in your laboratory notebook.** Do calculations in the notebook as well so that if you have questions later you can find what data you had and what you did with it. There will be at least one occasion where you will need data from a previous lab.
- **Wait until you have gathered all of your data before submitting any into LON-CAPA.** If your results are inconsistent or obviously in error, you should re-do any trials as needed before entering data.
- **In order for your PostLab to open, you must enter accepted data** (that is, to the correct number of significant figures and within any ranges that are set). You will get a message if not accepted, but be careful and take your time. Look to make sure your data are accepted.
- **We expect students to stay in the lab room for the entire lab period.** You may leave early only if you have completed the postlab questions for the experiment. If you leave lab early before you have finished your postlab questions or without the consent of your TA, we will assume you are committing academic dishonesty and you will earn a zero for the lab and postlab questions.

**3. PostLab Assignments.** These assignments consist mainly of calculations and data analysis of what you have done in lab. For some labs there will be some additional questions. If you have an excused absence, data will be provided for you to complete the assignment as scheduled. If you have an unexcused absence, you will **not** be able to complete the *PostLab* assignment. The *PostLab* assignments are found online via LON-CAPA and must be completed by **10:00 PM** the evening **before** your next lab (see the online Lab Schedule for the specific dates). Before the deadline multiple attempts are allowed but there is generally no feedback until after the assignment is due. Once the deadline has passed, your access to the *PostLab* assignment will be closed and will not be re-opened.

**4. Lab Cleanliness.** You are required to leave the lab in a clean and orderly manner each week. This includes, but is not limited to, cleaning the benchtop area where you have worked with soap and water, cleaning all lab glassware with soap and water and returning it to its proper location, turning off/unplugging/wiping clean all lab equipment that you used (i.e. spectrophotometer, hotplate, etc.), ensuring that you left the balances clean, throwing away used weigh boats in the trash, disposing of all waste in the proper receptacle, and any other requests made by your TA.

At the end of each lab period, your TA will walk through the lab space and ensure that the class has left the space in the proper condition. You will be given points, ranging from 0–3, for the condition of the lab each week. These points will be assigned to the class as a whole, not to individual students; therefore, it is not only important that you leave your area clean, but that you also encourage those students around you to do the same.

## ACADEMIC INTEGRITY

All answers entered into your LON-CAPA account must be due to your work. While you are encouraged to confer with others (your lab partner, TA, Course Director, etc.), the work you do must be your own.

To be clear, this also means that all data entered into the Lab assignments in your LON-CAPA account must be from the data you collect during your normally scheduled lab time. For example, it is not acceptable to “make-up” data that is accepted into LON-CAPA, or to use data from any other source that you know will work. Again, any data entered must be from you performing the experiment. If you enter any other data, you are guilty of “fabrication of data” (see [http://admin.illinois.edu/policy/code/Pocket\\_Code\\_web2012.pdf](http://admin.illinois.edu/policy/code/Pocket_Code_web2012.pdf) from the Student Code). The penalty for this could be as much as failing the course. That is, if you enter any data that you have not obtained in lab, even as only part of one experiment, you may receive a grade of “F” for the course. It is therefore also considered cheating if you give your data to a person who is not in lab.

To make sure students who enter data are present in lab, we do take attendance. Make sure that your TA knows you are in lab. Sign-in upon entering the lab, respond when your TA calls your name, and turn in a copy of your lab notebook with the data for that day’s experiment.

There are too many students and too many sections to allow students to switch sections; that is, you must attend the section in which you are enrolled (for an excused absence, see “Attendance for the Course”). Do NOT go to a different section and then submit your data during your scheduled time. You will not be counted as being present in the lab, and if data are entered, they will be considered to be fabricated.

## REQUIRED MATERIALS FOR THE COURSE

You are required to purchase the following for Chemistry 103:

### 1. Lab Coat

A lab coat can be purchased at any of the campus bookstores.

### 2. Goggles

All students, teaching assistants, instructors and visitors in the laboratory must wear regulation safety goggles as required by STATE LAW. You must wear goggles at all times in the laboratory or you will be asked to leave immediately. If you must be reminded to wear goggles in the laboratory, your TA will deduct points from your laboratory grade.

The approved goggles for Chem 103 is: *Honeywell Uvex Stealth OTG safety goggles*. Goggles can be purchased at any of the campus bookstores or online.

It is strongly advised that you do not wear contacts while in the laboratory. They readily absorb vapors from solvents that are detrimental to the eye. Safety goggles are not “air tight” and therefore do not completely eliminate this absorption. If you choose to wear contacts in the laboratory, you must notify your TA and wear a “\*CONTACTS\*” badge on your lab coat each week.

### 3. Chemistry 103 Laboratory Manual “General Chemistry Experiments”

You cannot use an old version of this manual this semester, as the course has been redesigned to include new experiments and policies. You must purchase the current version of the manual.

#### 4. Bound, Spiral Laboratory Notebook with Perforated Carbon Pages

These will be provided for you at the end of this manual. You don't need to purchase a separate lab notebook.

### ATTENDANCE FOR THE COURSE

Students are required to attend all laboratory periods. You must attend the section in which you are enrolled. All absences will be considered unexcused except in the following cases. Excuses must be submitted in a timely manner because the *PostLab* assignment will be due as scheduled, even if the lab is missed. A timely manner is within 6 days after the scheduled experiment. *PreLab* assignments are due as scheduled as well. NOTE: no more than three absences will be allowed (even excused) in order to pass the course.

1. **Medical excuse.** You must provide a signed doctor's note from a physician or from McKinley Health Center to the course director. If you are sick for an experiment, please email the course director as soon as possible.
2. **Family emergency.** If you cannot attend class because of an unexpected emergency you must provide documentation from the Emergency Dean to the course director. If you miss a lab due to an emergency, please email the course director as soon as possible.
3. **Participation in a University-sponsored activity.** Examples include participation in the Marching Illini or a University sports team. You must provide documentation regarding your absence to the course director at least one week prior to your absence. In addition, please contact the course director regarding your absence. Intramurals, student-sponsored clubs and activities, or registered student organization (RSO) events are **not** considered University-sponsored and do not excuse you from lab.

You will be working with a lab partner in each lab, and to be fair to your partner, you should show up on time to each lab. If you are more than 10 minutes late to lab, you will need to work by yourself on the experiment. Make sure to check-in with the TA first, and he/she will find a place for you to perform the lab. You will not be given extra time to finish the lab. If you do not have time to collect and enter all of your data, the *PostLab* assignment will not be accessible.

If you are more than 20 minutes late, you will not be allowed to perform the experiment. You will earn zero points for the Lab and *PostLab* LON-CAPA assignments.

You are required to dress properly each time you come to lab. If you are not dressed properly when you arrive to the lab you will be given two options:

1. Option 1: The student may leave the lab and receive a grade of a zero for that particular experiment.
2. Option 2: The student may choose to return home to obtain the proper lab attire or call a friend to bring them the proper lab attire. (*Note: If the student is waiting for the proper lab attire to be delivered, s/he must wait in the hallway.*)

If the student chooses option 2, the following stipulation applies: if the student returns to the lab more than 20 minutes after the start time of the lab (for example, if the lab starts at 12:00 pm and the student returns at 12:21 pm), s/he will not be permitted to complete the lab, even though s/he

now has the proper attire because it took too long to obtain, and the student will receive a grade of a zero for that particular experiment.

## GRADING FOR THE COURSE

Please note: Chemistry 103 follows the University plus/minus system for grading.

The grading for the course will be as follows

12 <i>PreLab</i> assignments (10 points each) . . . . .	120 pts.
12 Lab reports* (10 points each) . . . . .	120 pts.
12 <i>PostLab</i> assignments (20 points each) . . . . .	240 pts.
12 Lab Cleanliness (3 points each) . . . . .	36 pts.
<b>Total . . . . .</b>	<b>516 pts.</b>

\*Lab reports consist of you entering data into your LON-CAPA account during lab, and turning in a copy of your data and observations to your TA. Unless you have an excused absence, both of these must be completed for you to receive credit for the lab report and access to and credit for the *PostLab* assignment.

This course is not curved (i.e. 70.0–72.9% is a C-, 73.0–76.9% is a C, 77.0–79.9% is a C+, 80.0–82.9% is a B-, 83.0–86.9% is a B, 87.0–89.9% is a B+, 90.0–92.9% is an A-, and 93.0–100% is an A).

### Grading Scheme for Chem 103:

Percentage %	Final Grade
(97.0-100.0%)	A+
(93.0-96.9%)	A
(90.0-92.9%)	A-
(87.0-89.9%)	B+
(83.0-86.9%)	B
(80.0-82.9%)	B-
(77.0-79.9%)	C+

Percentage %	Final Grade
(73.0-76.9%)	C
(70.0-72.9%)	C-
(67.0-69.9%)	D+
(63.0-66.9%)	D
(60.0-62.9%)	D-
(0.0-59.9%)	F

## OTHER IMPORTANT COURSE INFORMATION ITEMS

### 1. Medical Insurance

Each student at the University is responsible for providing his/her own medical insurance coverage. If a student is injured or becomes ill during laboratory, costs of transportation and treatment are the responsibility of the student. Check to be sure that your insurance coverage is adequate.

### 2. Contact Information

If you have any questions or concerns throughout the semester, you should contact the Course Director. The contact information is included online.

## THE LABORATORY NOTEBOOK

You will keep a record of each experiment you complete in the laboratory notebook pages provided for you (towards the end of the lab manual). At the end of each laboratory period you will submit the original record to your TA and keep the copies of these pages in your notebook for your records and for use on the *PostLab* assignments.

Record tables, data, and observations in ink—pencil will not be accepted. The record of each experiment should be in a format that allows convenient organization of pertinent data and observations. Carefully read the entire experiment before coming to lab. This will help you visualize the purpose and procedure and organize your work.

You should prepare the laboratory notebook before coming to lab. The report for each week's experiment should begin at the top of a new page. The following should be completed before you come to lab:

- Include the title of the experiment at the top of the first page along with your full name and date.
- Reproduce all of the data tables for the experiment.
- Include any calculations described in the *Before Coming to Lab* section of the particular experiment.