Spring 2016
Capstone Assignment- CHE210-General Chemistry I
Lab Final Project
Capstone Assignment
General Chemistry-Spring 2016

This lab final project represents the capstone experience for students developing lab experiments in a General Chemistry I (CHE210) course for Science, Forensic and Engineering majors. The lab sequence is described in the item 6.1. This lab sequence is part of a whole course that also includes a weekly 3-hour lecture and a 1-hour recitation devoted to solving problems. During the first lecture, students receive a class syllabus containing lecture, recitation and lab information. During the first lab session, students also receive a handout further explaining lab guidelines and expectations.

1-Assignment Rationale

The development of scientific literacy and disciplinary knowledge are critical foundations to support Science and Engineering student transition to senior college STEM majors. Specifically, critical thinking, quantitative reasoning, scientific writing skills and, the ability to assess their own results are essential for this necessary difficult transition to 4 year-institutions. The lab component of science courses can develop these skills as students perform experimental work and write lab reports based on it. This capstone assignment aims to create a culminating experience for General Chemistry I students who will demonstrate the quantitative reasoning progress after writing and revising several lab-reports previously. This final practice will also intellectually challenge student to apply learned skills in a new scenario, create an experimental design and self-evaluate proposed hypothesis.

2- General Chemistry I course-Student Learning Outcomes

By the end of the course, students will:
- Know the basic principles and topics of Chemistry and their application to real world problems
- Solve problems ranging from simple to complex Chemistry calculation based on the covered materials
- Use chemical terminology to explain aspects ranging from engineering problems to everyday life situation
- Demonstrate to think critically about a Chemistry problem, devise a strategy for solving it, and assess whether the results make sense

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- Relate Chemistry to all areas of science
- Connect diverse topics of Chemistry
- Manipulate basic laboratory equipment
- Apply proper chemistry procedures related to separation techniques, stoichiometry, chromatography, calorimetry, gravimetry, etc.

3- Capstone Assignment Student Learning Outcomes

At the end of the capstone project, student will

- Develop student quantitative reasoning skill
- Enhance their ability to evaluate, reflect on and self-assess their own work
- Be able to apply learned skills in a new context
- Be able to create new experimental designs based on produced data

4- Capstone Assignment General Education Competencies

Students will develop the following Gen Ed education competencies after completion of this assignment:

A.3 (Category A: Skills): Distinguish factual information from subjective opinion; consider informal origin in analyzing relevance in order to represent content in a clear, succinct and logical manner

C.3 (Category: Synthesis and Application): Organize, analyze, evaluate, and treat information critically to use and present it in a cohesive and logical fashion

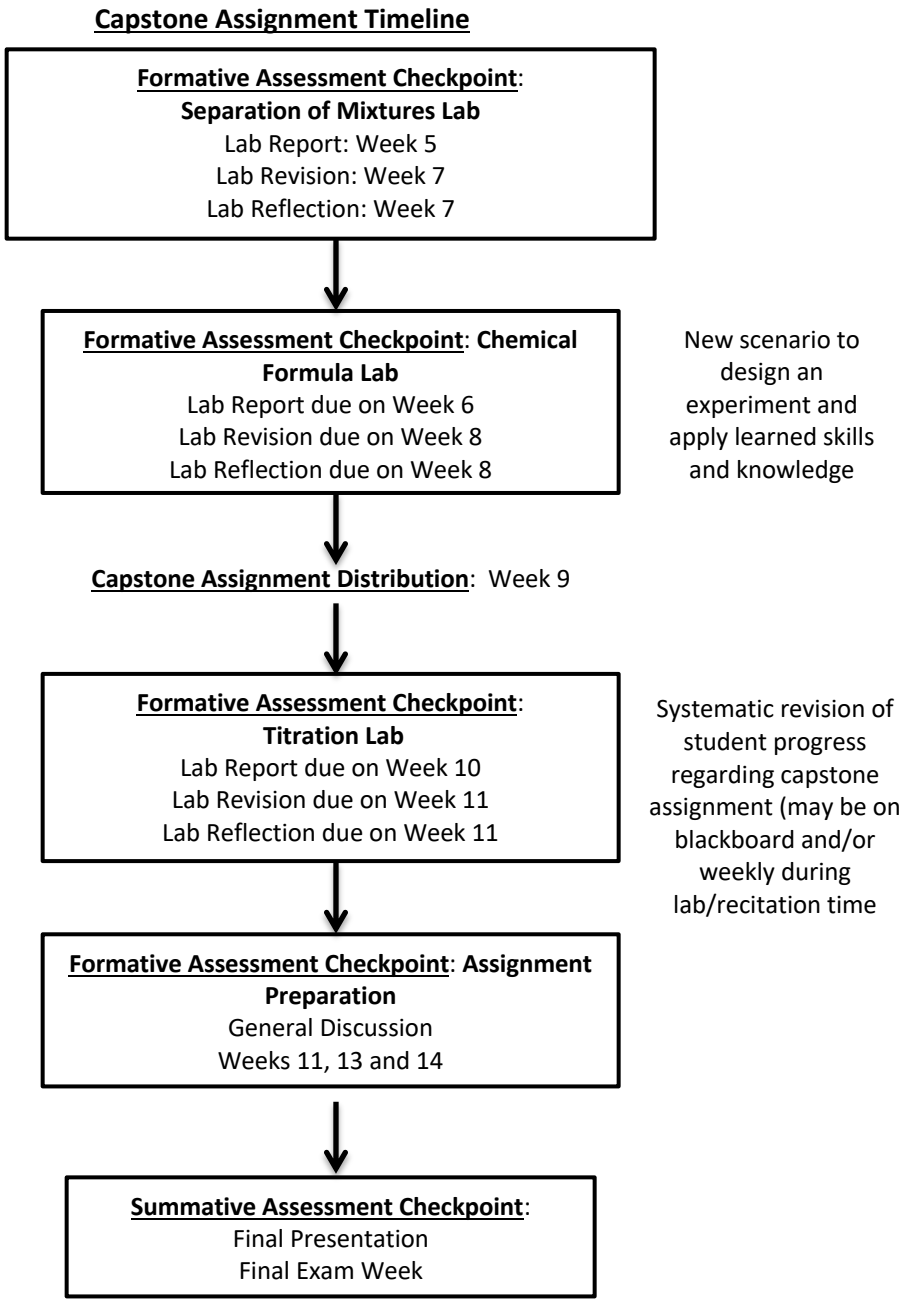
C.4 (Category: Synthesis and Application): Interpret data and observations; comprehend research material. Be able to present and explain conclusions.

5- Capstone Assignment Implementation

Student will receive an experimental scenario based on research questions. They will create the experimental design and to hypothesize the potential answers that proposed experimental techniques might give them. They must suggest experimental approach combining two to three experimental methods developed in previous lab works. See lab experiments sequence on page 3 to 7. They must demonstrate ability to apply learned techniques in new scenarios and assess potential answers. This capstone assignment will be distributed and explained on week 8. By this time, students have performed six new lab experiments and, revise and reflect on two of them. See attached sequence of experiments. They will develop the project in the subsequent weeks. They will performance 5 additional lab procedures. One of these ones will be also revised. Students will discuss their work with the instructor during final weeks of classes and present their results as poster presentation (electronic version only) during the final exam week.

6- Capstone Assignment Timetable

Week 1 to Week 7: Students will perform six lab experiments. They will write six lab reports, revise two of them and reflect on the process.
Week 8: Assignment will be distributed.
Week 9-13: Students will develop the capstone assignment. In parallel, they will develop five more lab experiences. One of these ones will be revised.
Week 14: Assignment Group discussion
Final Exam-Week: Assignment Presentation



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6.1: Schedule of Experiments

DATE	EXPERIMENT	EX PT #	PAGE	WEEK EXPECTATIONS AND DEADLINES
Week 1	Drawer assignment Discussion of Safety Rules for Laboratory Sessions Attendance and Grading Policies Directions for Writing a Laboratory Report and Flow Charts Lab 1: Basic Laboratory Techniques (to be concluded in the second lab period)	1	1	- Lab Report guidelines distribution and explanation
Week 2	Lab 1 continuation			- Lab Flow Chart Explanation - Discussion about Lab Report Writing
Week 3	Lab 2: Identification of Substances by Physical Properties Assignment: Elaborate Flowchart and write Lab report	2	17	- DUE: Lab Report 1
Week 4	Lab 3: Separation of the Components of a Mixture Assignment: Elaborate Flowchart and write Lab report. This lab report will be revised.	3	29	- DUE: Lab Report 2 - Lab Report 1 will be returned with recommendations
Week 5	Lab 4: Chemical Formulas (Part B). This lab report will be revised. Assignment: Elaborate Flowchart and write Lab report This lab report will be revised.	5	47	- DUE: Lab Report 3 - Lab Report 2 will be returned with recommendations
Week 6	Lab 5: Chemical Reactions (Parts B and C) Assignment: Elaborate Flowchart and write Lab report	4	37	- DUE: Lab Report 4 - Lab Report 3 will be returned with recommendations - Lab Report 3 Revision and Reflection Guidelines will be distributed
Week 7	Lab 6: Paper Chromatography: Separation of Cations (Part B) Gas Chromatography (Demo) Assignment: Elaborate Flowchart and write Lab report	10	97	- DUE: Lab Report 5 - DUE: Lab Report 3 Revision and Reflection

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				- Lab Report 4 will be returned with recommendations - Lab Report 4 Revision Guidelines and Reflection will be distributed
Week 8	Capstone Assignment Distribution (Discussing Assignment Mechanics and Expectations) (A lab experience has been removed) Discuss expectations for each checkpoint meeting	7	67	DUE: Lab Report 6 DUE: Lab Report 4 Revision and Reflection - Lab Report 5 will be returned with recommendations
Week 9	Lab 7: Titrations of Acids and Bases (Part B) Assignment: Elaborate Flowchart and write Lab report. This lab report will be revised.	20	215	DUE: Capstone first draft/Checkpoint - Lab Report 6 will be returned with recommendations
Week 10	Lab 8: Calorimetry (A Virtual Lab about titration can substitute this lab) Assignment: Elaborate Flowchart and write Lab report Capstone Assignment Checkpoint: 20 minutes	HA ND	OUT	-DUE: Lab Report 7 - DUE: Capstone second draft/checkpoint
Week 11	Lab 9: Behavior of Gases: Molar Mass of a Vapor (Part B) Assignment: Elaborate Flowchart and write Lab report Capstone Assignment Checkpoint: 20 minutes	13	137	DUE: Lab Report 8 - DUE: Capstone third draft/checkpoint Lab Report 7 will be returned with recommendations - Lab Report 7 Revision Guidelines and Reflection will be distributed
Week 12	Lab 10: Gravimetric Analysis of a Chloride Salt Assignment: Elaborate Flowchart and write Lab report. Capstone Assignment Checkpoint: 30 minutes	8	77	DUE: Lab Report 9

				DUE: Lab Report 7 Revision and Reflection - DUE: Capstone fourth draft/ checkpoint
Week 13	Lab 11: Colorimetric Determination of Iron/Parts A and B (Calibration Curve/Unknown) Assignment: Elaborate Flowchart and write Lab report	33	423	- DUE: Capstone fifth draft/checkpoint
Week 14	Final Project Preparation Week 13 and Week 14 labs will be developed on week 13.	33	423	DUE: Lab Report 10 DUE: Lab Report 11 DUE: Capstone sixth draft/checkpoint
Final Exam Week	**Final Project Presentation**			

7- Capstone Assignment

All students must provide a final written project. Randomly, three students will be selected to present. One student from each of the three different versions of the assignment will be selected. Alternately, students might present poster (electronic version) to explain their results. The adoption of this second format will depend on outcomes from oral presentation format.

Capstone Assignment

You are a research scientist at Fun-Chemistry Pharmaceutical Company. Your duty is to develop below experimental procedure accurately. During this work, calculations are involved, and conclusions need to be reached. Note, you need to select/apply lab procedures performed in our lab sequence along the semester. Some of the following techniques should be required to design the experimental work: Separation of mixtures, Chemical Formula, Titration, Colorimetric Analysis, Chromatography, Calorimetric analysis, and Gas Release.

1) Determine the experimental procedure
2) Flow Chart must be shown and rationale for chosen technique must be explained for each step
3) Select techniques to be used and the sequence of experiments. Explain the rationale of this selection
4) Data

Final Work: A scientific paper following the same format used for lab report is due at the final lab exam date. This final narrative is meant to document below experiments, the results you obtained, and your interpretation of those results. The report must be typed using Times New Roman 12-point font, single-spaced, with 1-inch margins. The report is a scientific paper, and so you must communicate following the standards that are used by scientists to report their findings. Please carefully read the guidelines provided for writing lab reports. This final paper should contain each of the following six sections: Title Page, Abstract, Introduction and Objective, Materials and Methods (Flow Chart), Results and, Discussion and Conclusions.

Timeline:

Tuesday of Week 8th: Assignment Distribution

Each Tuesday of Weeks 9, 10, 11, 12, and 13: Checkpoint to discuss work progress with the instructor during lab time. Please, bring your work in progress-narrative.

Tuesday of Week 14: Paper discussion in preparation for the final paper presentation

Tuesday of Final Exam Week: Final Paper Presentation

Experimental Work: (Example of theoretical frame provided to the students to develop their final work)

Experiment 1: You must determine the empirical formula of a compound containing Iron and Sulfur. During your experiment, you weighed the crucible, cover and iron (Fe) and the weight was 20.36g. The weight of crucible and cover was 17g.

Question 1.1: what is the weight of iron (Fe)?

You heated the crucible containing iron (Fe) and added sulfide (S) into the crucible. You made sure the reaction was complete and unreacted sulfide was removed by burning. You weighed the crucible, cover and the end-product iron sulfide and the weight were 23.24g.

Question 1.2: Calculate the weight of sulfur (S).
The molecular mass of iron (Fe) is 56g/mole. The molecular mass of sulfide (S) is 32g/mole.
Question 1.3: calculate the moles of iron (Fe) and sulfide (S) used in the experiment and predict the chemical formula of Iron sulfide.
Experiment 2: You need to determine the concentration of Potassium hydroxide.
You had a flask of HCl (hydrochloric acid) solution containing indicators. Indicators change colors at different Ph values. Used indicator changes to pink in alkaline and to colorless in acid. You used KOH (alkaline) to neutralize the HCl solution in your flask. At the end of the titration, the entire solution changed color into pink and HCl was neutralized.
Question 2.1: please write down the balanced chemical equation.
You found out that you used 10ml of KOH solution containing to neutralize 30ml of a solution containing 4.2 grams of HCl. The molecular weight of KOH was 56.1g/mole and the molecular weight of HCl was 36.5g/mole.
Question 2.2: Calculate the moles of KOH used during titration.
Question 2.3: What was the molarity of your KOH solution?
Question 2.4: How many grams of KCl (molecular weight 74.6g/mole) were produced?
At the end of your experiment, you evaporated all the water in your end solution and obtained the pure KCl, potassium chloride.
Question 2.5: Please calculate this amount, assuming 89% of efficiency.

Six months later, you found that you accidentally mixed the total amount of iron sulfide obtained from experiment 1 with 0.8 grams of NH_4Cl (ammonium chloride) and the total amount of potassium chloride obtained from experiment 2. KCl is soluble in water. Iron sulfide is not soluble in the water.
Question 2.6: please design and describe a procedure to separate potassium chloride, iron sulfide and ammonium chloride from each other.
Question 2.7: If at the end of the experiment, you recover 0.3 more grams of the total initial amount, what may be the source of mistake?
Question 2.8: If at the end of the experiment, you recover 0.3 less grams of the total initial amount, what may be the source of mistake?

8- Evaluation Plan

A rubric system for assessing Quantitative Reasoning has been modified from the AACU VALUE QL Rubric. This system assesses five categories of quantitative reasoning: Calculations, Representation, Interpretation, Assumptions, and Application/Analysis. Below are the highest score qualifiers for each category:

- Calculations: *Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem. Calculations are also presented elegantly (clearly, concisely, etc.)*
- Representation: *Skillfully converts relevant information into an insightful mathematical portrayal in a way that contributes to a further or deeper understanding.*
- Interpretation: *Provides accurate explanations of information presented in mathematical forms. Makes appropriate inferences based on that information.*
- Assumptions: *Explicitly describes assumptions and provides compelling rationale for why each assumption is appropriate. Shows awareness that confidence in final conclusions is limited by the accuracy of the assumptions.*
- Application and Analysis: *Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.*

Evaluation Plan: Lab Report and Capstone Assignment Guidelines

Laboratory----------30% of the final grade

- Flow chart, Initial Question, and Goggle wearing, ----------5%
- -, Revised Lab reports, Final Lab Exam ----------10%
- Lab Reports and Lab work----------15%

Attendance and Lateness

All Science students missing four (4) labs or having a failing grade in lab will receive an F in the whole class.

Lab Work: All students are expected to have hands on experience during the lab time; therefore, arriving more than 10minutes late will negatively affect the lab work grade.

Safety: For your safety, you must always wear goggles during the lab procedure. This is mandatory, and if you are not wearing goggles you will lose points in your laboratory grade.

Weekly Lab Assignments

At the beginning of each lab, you are expected to submit the following:

- Lab report from the previous laboratory experience
- Flow chart for the experiment to be performed this day
- Initial question (for on-time students only)

Lab Report: A laboratory report is due the following week after each lab experience. The report is meant to document and describe your experiences and findings in the lab. To receive full credit, your report must follow the guidelines described in the section below.

Flow Chart: A diagrammatic conceptual map of the lab steps to be performed is due at the beginning of the lab. A flow chart is a type of diagram that represents a process. It shows the steps as a series of boxes with their order shown by connecting them with arrows. Process operations are represented in the boxes, and the arrows connecting them represent the flow of control. The flowchart represents the sequence of operations to be performed and is intended to guide you during the lab procedure. The flowchart must be enclosed in the lab report that is handed in the following week.

Initial Question: A 5 minute-written question will be at the beginning of each lab session. Your own flow chart can be used during the question. Latecomers will not be allowed to answer this question.

Revised Lab reports/Final Assignment presentation: Three lab reports will be revised. A final assignment will be distributed during week 8th. Specific guidelines will be provided for all these assignments.

Guidelines to Writing a Laboratory Report

Each laboratory report is due the following week after the lab experience. A laboratory report is meant to document the experiments you performed in the laboratory, the results you obtained, and your interpretation of those results. The report must be typed using Times New Roman 12-point font, single-spaced, with 1-inch margins. The report is a scientific paper, and so you must communicate following the standards that are used by scientists to report their findings. Please carefully read the guidelines below, as they will help you to write quality laboratory reports.

A laboratory report should contain each of the following six sections:

- Title Page: 5 points
- Abstract: 5 points
- Introduction and Objective: 10 points
- Materials and Methods: 10 points
- Results: 40 points
- Discussion and Conclusions: 30 points

Each section contains essential elements that are present in every well-written laboratory report. Below you will find a description of each section, the purpose of that section, and the essential elements that make up the section. To receive the highest grade, your laboratory report must score "excellent" for every element in each section of the report.

Title Page (5 points)

The title page should include the name of the laboratory experiment, your name, the name of the professor, and the name of the class.

Abstract (5 points)

The abstract should be a concise (short) and specific summary of the laboratory report that allows readers to decide whether they want to read the report. It should include the purpose of the experiment, the methods used, the results obtained, and the conclusions you drew from the results. Although the abstract is the first paragraph that appears in your report, it should be the *last* part of the report that you write.

Essential Elements for Abstract:

	Proficient (5 points)	Intermediate/Competent (2-4 points)	Novice (0-1 points)
Purpose of experiment	Purpose of experiment is clearly and concisely stated	Purpose of experiment is stated but is unclear or poorly worded	Purpose of experiment is very poorly stated or missing
Methods used	Method is clearly, concisely, and accurately stated	Method is stated but is unclear, poorly worded, or partially inaccurate	Method is very poorly stated, inaccurate or missing

Results, with error limits and correct units	Results are clearly stated with all correct error limits and units	Results are stated but partially inaccurate or missing some error limits or units	Results are incorrectly stated or missing.
Conclusion	Conclusion is clearly stated and reflects deep understanding of the significance of the results	Conclusion is stated but only partially reflects understanding of the significance of the results	Conclusion does not address significance of the results or is missing.

Introduction and Objectives (10 points)

Introduction: It includes relevant background information based on facts and published literature that is relevant to the experiment's objective. It also includes the importance of the topic and the significance of conducting this experiment (No more than one or two paragraphs at this level).

Objectives: A statement of the intention or purpose of the lab. It answers the following questions:

What do you want to demonstrate in this experiment?

What do you hope to learn from this experiment?

	Proficient (10 points)	Intermediate/Competent (5-9 points)	Novice (0-4 points)
Relevant background information on the topic (2)	Clearly stated, conceptually correct, grammatically correct	Conceptually correct, but not clearly stated and includes grammatical errors	Conceptual errors, not clearly stated and includes grammatical errors
Significance of this experiment (3)	Clearly stated, conceptually correct, grammatically correct	Conceptually correct, but not clearly stated and includes grammatical errors	Conceptual errors, not clearly stated and includes grammatical errors
Purpose/objective of this experiment (5)	Clearly stated, conceptually correct, grammatically correct	Conceptually correct, but not clearly stated and includes grammatical errors	Conceptual errors, not clearly stated and includes grammatical errors

Materials and Methods (10 points)

The materials and methods section describes how you performed the experiment. It should contain all the important information about the experiment, including the equipment used, the

chemicals used, and the sequential steps you performed in the experiment. Start with a description of the chemicals you used. Include the source, grade, and method you used to purify them. If you used chemicals as supplied without further purification, say so. A diagram of instrumentation used in the experiment can be helpful. Be complete, accurate, and precise. Do not give details that are common knowledge in the field, but do provide information of particular interest, such as the brand name and model of a complicated apparatus or unusual equipment (for example, Oscilloscope – Tectronix Model 561B-CRO-158, Serial #123456789).

For the experimental procedure, you should use clear paragraph organization to list all steps in the correct order. Be complete. You should provide enough information so that another person could use your description to replicate (repeat) the experiment. However, you should also be concise and not provide extra information that does not help the reader understand how you performed the experiment. State what you actually did, in the past tense, and do not just repeat the steps given in your textbook.

Essential Elements for Materials and Methods:

	Proficient (10 points)	Intermediate/Competent (5-9 points)	Novice (0-4 points)
Description of chemicals and equipment used (5)	All chemicals and equipment used are correctly described.	Chemicals and equipment are described but description is partially inaccurate or incomplete.	Descriptions of chemicals and equipment are mostly inaccurate, incomplete, or missing.
Description of experimental methods (5)	Description of methods of complete, accurate, clear, and concise. A reader would be able to reproduce the experiment.	Description of methods is partially incomplete, inaccurate, or unclear.	Description of methods is poorly written or missing. A reader would not be able to reproduce the experiment.

Results (40 points)

In the results section, you will take the data you obtained from performing the experiment and present it in an understandable way to the reader. State and describe what you observed in the experiment and all your quantitative and qualitative findings. The lab manual sheet will help you with the expected information to be documented. To achieve this when working with numerical data, you must perform **calculations** to transform the raw, observed data into an appropriate form and show all your calculations/work in entirety. You must then **represent** that data in a visual way that the reader can easily observe. For simple data, this can be done by connecting it to a *mathematical formula*. For more complicated data, it can be done by making a *figure ex. (tables, charts, graphs)* that must be correctly labeled. Finally, you must **verbalize** the data by describing them to the reader in paragraph form. Make sure not to **discuss/interpret** your results in this section (do not describe WHY you found what you found).

	Proficient (40 points)	Intermediate/Competent (20-39 points)	Novice (0-20 points)
Text to describe your data (20)	All data from experiments are included	Everything is included, but some of the data are incorrect or incomplete	Too many errors or very incomplete
Figures (Tables and graphs) (10)	Accurate representation of data, clearly labeled, complete with correct descriptions	Some labels are missing, but representation of data and descriptions are accurate	Inaccuracy or incompletion in all areas
Formulas/ calculations (10)	Correct formulas are being used; all calculations/work are correct	Correct formula is used, but errors in calculations	The calculations are entirely incorrect and/or the formulas used are incorrect

Discussion and Conclusions (30points)
You must explain and analyze your results. You must n provide evidence that you understand the material you are presenting. The underlying question for this section is, "What is the significance of the results?" Unlike the Materials and Methods and Results sections, which should be written in a straightforward manner, the Discussion is an opportunity for you be thoughtful. Before starting your discussion, think about the following points:

1. Carefully examine each of the figures and formulas. In the Results section you simply described each piece of visual data in written form. Here you should **analyze** the data with a little more depth:
    - What conclusions can you draw from the figures and formulas?
    - Do you observe any trends in the data?
    - Can you make any predictions based on the figures and formulas?
    - Compare the expected results from those you observed. Before starting the experiment, what results did you expect to find? Did you observe these results? If there are differences between the expected and observed results, how can you account for them?
2. In every experiment there are **assumptions** made when you are drawing conclusions about the data. To fully understand an experiment, you should try to identify the assumptions you are making. Consider the following:

- What was the stated objective of the lab? Why was the *design* of the experiment appropriate to reaching that objective?
- Are there any flaws or limitations in the design of the experiment that could prevent the objective from being met?
- Is there anything about how the experiment was designed that could be improved?
- Can you think of any other experiments or approaches that would meet the same objective of the experiment?
- Did you encounter any difficulties in *performing* the experiment? If so, what were their sources? How might these difficulties have affected the results of the experiment? How might they be avoided in future experiments?

Your discussion should touch on the themes above. They do not have to be in any specific order, if you clearly explain the significance of your findings. Remember that the goal of the discussion section is to draw significant and insightful conclusions from the data you obtained. If you did not obtain the expected results, it is important to present this openly and try to provide an explanation. In science, unexpected results are just as important as expected ones. Like other sections, the discussion should be clear and concise, and should not have overgeneralizations or personal feelings.

Essential Elements for Discussion:

	Proficient (30 points)	Intermediate/Competent (10-29 points)	Novice (0-10 points)
Discussion of experimental design **	Judgments are made about the design of the experiment and the limitations of the design.	Judgments are attempted about the design of the experiment and limitations of the design, but are partially unclear, incomplete, or inaccurate.	Judgments about experiment design are poorly worded, unclear, inaccurate, or missing.
Discussion of experimental performance **	Judgments are made about how the experiment was performed and possible sources of experimental error.	Judgments are attempted about sources of experimental, but are partially unclear, incomplete, or inaccurate.	Judgments about experiment performance are poorly worded, unclear, inaccurate, or missing.
Analysis of results and conclusions	Conclusions are correctly made based on an accurate analysis of the figures and formulas presented in the report. Expected and obtained results are compared and any discrepancies are completely addressed. An understanding of the significance of the results is clearly shown.	Conclusions are made, but the analysis of the figures and formulas is partially incomplete, inaccurate, or lacking in depth. Expected and obtained results are compared and discrepancies are partially addressed. Some understanding of the significance of the results is shown.	Conclusions are unclear, poorly worded, or missing. Analysis of figures and formulas is inaccurate or missing. Expected and obtained results are not compared or discrepancies not addressed. Understanding of the significance of the results is not shown.

Writing Style	Discussion avoids general/vague statements and use of personal feelings.	Discussion includes some general/vague statements or personal feelings.	Discussion includes several instances of general/vague statements or personal feelings.

*** Indicates QR specific assessments*

Source: Modified from Gragson and Hagen, 2010, JCE

9- Appendices

A- Guidelines to Revise Separation of Mixtures (Current ones are under revision)
B- Guidelines to Revise Chemical Formula (Current ones are under revision)
C- Guidelines to Revise Titration (Current ones are under revision)
D- Questions to Reflect on Lab report revisions and Capstone Assignment

A- Separation of Mixtures Lab Revision: Developing your Quantitative Reasoning Skills

(One page summary)

1) Indicate Lab name, your name, professor name and class number
2) Included lab goal
3) Include results (in a table), use lab manual format
4) Rewrite your conclusions by discussing possible sources of discrepancy between your results and the theoretical expected results. The theoretical percent of each mixture component has been provided. Use guidelines for results, discussion and conclusions provided in the lab report guidelines.
5) Enclose the original lab

One page summary format:

(Typed, Times New Roman, 12 font, no spacing, 1 inch margin)

- Lab Name
- Student name
- Professor name
- Class number

- Lab goal
- Lab results (in a table format)
- Lab conclusion (a 200–300-word paragraph) is expected

Rewrite your conclusions by discussing possible sources of discrepancy between your results and the theoretical expected results. The theoretical percent of each mixture component has been provided. Sources of mistakes should be explained when discrepancies come up after this comparison. Inferences based on logical reasoning using quantitate data are expected. Student shall offer explanation of the results and potential further directions. What can be done differently if you do the experiment again? Did you recover 100% of the initial mass? Not? Why?

B- Chemical formula Lab Revision: Rethinking Laboratory Discussion

1) Indicate Lab name, your name, professor name and class number
2) Included lab goal
3) Include results (in a table), use lab manual format
4) Rewrite your conclusions by discussing possible sources of discrepancy between your results and the theoretical expected results. Theoretical result: molecular mass of Cu_2S=159g/mole (32g of S per mole of Cu_2S and 127 grams of Cu per mole of Cu_2S). Use guidelines for results, discussion and conclusions provided in the lab report guidelines.
5) Enclose the original lab

One page summary format:
(Typed, Times New Roman, 12 font, no spacing, 1 inch margin)

- Lab Name
- Student name
- Professor name
- Class number
- Lab objective
- Lab results (in a table format)
- Lab conclusion (a 200–300-word paragraph) is expected

C- Titration Lab Revision: Rethinking the Laboratory Discussion

1) Indicate Lab name, your name, professor name and class number
2) Included lab goal
3) Include results (in a table), use lab manual format
4) Rewrite your conclusions by discussing possible sources of discrepancy between both end point titration volumes. Can you please further discuss the KHP percent obtained based on your titration volume? Molarity of used NaOH: XXX. Use guidelines for results, discussion and conclusions provided in the lab report guidelines.
5) Enclose the original lab

One-two page summary format:
- Lab Name
- Student name
- Professor name
- Class number

- Lab goal
- Lab results (in a table format)
- Lab conclusion (a 200–300-word paragraph) is expected

D- Questions to Reflect on Lab report revisions and Capstone Assignment

- Reflection on Separation of Mixtures Lab Revision:
- Reflection on Chemical Formula Lab Revision:
- Reflection on Titration Lab Revision
- Reflection on Capstone Assignment

The student reflection on lab report revision and capstone assignment will be developed as an ongoing process developed along the semester. Students will revise three of the ten written lab reports. Along with the revision process, students will reflect on their own thinking process, barriers and accomplishments related to the process. These three reflecting pieces are developed during the first 10 weeks of the term. Thus, students will understand the assignment expectations when receiving a fourth requirement for reflecting on the capstone assignment by week 10th.

CHE210-Capstone Progress-Reflection
Separation of Mixtures Lab Revision: Reflecting about the data analysis and lab reasoning processes

(One page summary)

One page summary format:
(Typed, Times New Roman, 12 font, no spacing, 1 inch margin)

- Lab Name
- Student name
- Professor name
- Class number

1) What was the most difficulty part of the lab experience and the lab report writing? Explain

2) How did you solve any problem or obstacle during the lab experience and/or the lab report writing?

3) Did working in-group help you? Why?

4) Could you be able to identify source mistakes? How? Explain

5) Did you have previous experience writing lab reports? If so, from which class? If so, has this previous experience been useful to write and revise lab reports in this course? Explain.

6) Do you think this experience will help you writing scientific narratives in the future? Explain

7) Do you think that lab report guidelines were helpful? Explain. Do you think it should be improved for future courses? If so, how?

8) Did you enjoy the lab? Explain

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CHE210/Capstone Progress-Reflection
Chemical Formula Lab Revision: Reflecting about the data analysis and lab reasoning processes

(One page summary)

One page summary format:
(Typed, Times New Roman, 12 font, no spacing, 1 inch margin)

- Lab Name
- Student name
- Professor name
- Class number

1) What was the most difficulty part of the lab experience and the lab report writing? Explain

2) How did you solve any problem or obstacle during the lab experience and/or the lab report writing?

3) Did working in-group help you? Why?

4) Could you be able to identify source mistakes? How? Explain

5) Did you have previous experience writing lab reports? If so, from which class? If so, has this previous experience been useful to write and revise lab reports in this course? Explain.

6) Do you think this experience will help you writing scientific narratives in the future? Explain

7) Do you think that lab report guidelines were helpful? Explain. Do you think it should be improved for future courses? If so, how?

8) Did you enjoy the lab? Explain

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CHE210-Reflection
Titration Lab Revision: Reflecting about the data analysis and lab reasoning processes

(One page summary)

One page summary format:
(Typed, Times New Roman, 12 font, no spacing, 1 inch margin)

- Lab Name
- Student name
- Professor name
- Class number

1) What was the most difficulty part of the lab experience and the lab report writing? Explain

2) How did you solve any problem or obstacle during the lab experience and/or the lab report writing?

3) Did working in-group help you? Why?

4) Could you be able to identify source mistakes? How? Explain

5) Did you have previous experience writing lab reports? If so, from which class? If so, has this previous experience been useful to write and revise lab reports in this course? Explain.

6) Do you think this experience will help you writing scientific narratives in the future? Explain

7) Do you think that lab report guidelines were helpful? Explain. Do you think it should be improved for future courses? If so, how?

8) Did you enjoy the lab? Explain

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CHE210-Reflection
Capstone Progress-Reflection

(One page summary)

One page summary format:
(Typed, Times New Roman, 12 font, no spacing, 1 inch margin)

- Lab Name
- Student name
- Professor name
- Class number

1) Could you be able to clearly understand assignment guidelines? Please, explain any obstacle understanding the assignment expectations.

2) Could you be able to identify previously developed techniques required to craft this experimental design? If so, can you explain how you did or were able to identify it?

3) Could you be able to integrate the different lab procedures to design the requested experimental design? Explain

4) Do you believe this capstone assignment develop your scientific reasoning skills? Specifically, scientific writing skills, problem solving and analytical reasoning skills. Explain

5) Did previous lab report writing, and revision processes help you to put together this final capstone assignment? Explain

6) Can you explain the difference between results, discussion, and conclusions? You can use a concrete example from previous lab experiences to support this explanation.

7) Did you enjoy working on this capstone assignment? Explain

8) Anything else you want to add

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