SCIE2103 Chemistry Lab

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I. CBU PROFESSOR BIO

Jeffrey R. Christianson, Ph.D., is Professor of Science and Worldview at Vyrsity and Colorado Biblical University. He is also a Data Scientist, has previously held a Postdoctoral Researcher appointment (computational chemistry) in the Chemical Engineering department at the University of Delaware, and served as a Graduate Researcher (theoretical physical chemistry) and Teaching Assistant (general chemistry) in the Chemistry department at the University of Wisconsin – Madison, where he received his Ph.D. in Physical Chemistry. He received B.S. degrees in Chemistry and Mathematics from Truman State University.

II. COURSE DESCRIPTION

This course provides an introductory laboratory experience in the field of Chemistry for non-science majors. Learners will gain experience with standard laboratory approaches and techniques such as the scientific method, instrument design and calibration, safely performing chemical reactions, qualitative substance identification, gravimetric analysis, and titration. The course is designed to be a hands-on supplement to SCIE2101 to equip the Learner with an experiential understanding of and appreciation for the process of exploring chemistry (and natural sciences in general) with an emphasis on critically analyzing and applying that process.

Module 1: Getting Started
Online Manual: Getting Started
Lab Evaluation: Getting Started
Lab Questions #1

In this module the Learner will become familiar with the contents of the lab kit and the structure of a typical lab using the vendor's website.

Module 2: Laboratory Safety
Online Manual: Laboratory Safety
Lab Evaluation: Laboratory Safety
Lab Questions #2

In this module the Learner will set up an at-home lab station and demonstrate an understanding of basic safety practices in the lab. The Learner will review home laboratory safety equipment, learn how to read a safety data sheet, and review basic safety concepts.

Module 3: The Mole Concept
Online Manual: The Mole Concept: Chemical Formula of a Hydrate
Lab Evaluation: The Mole Concept: Chemical Formula of a Hydrate
Lab Questions #3

In this module the Learner will make a connection between the macroscopic domain and the microscopic and symbolic domains. The Learner will use mass difference before and after heating and the concept of the mole to determine the chemical formula of a hydrated potassium aluminum sulfate sample (alum). This module can be completed alongside SCIE2101 Module 1.

Module 4: Molecular Modeling and Lewis Structures
Online Manual: Molecular Modeling and Lewis Structures
Lab Evaluation: Molecular Modeling and Lewis Structures
Lab Questions #4

In this module the Learner will develop a more intuitive understanding of molecular structure by constructing three-dimensional models of multiple types of molecules. It is strongly encouraged to complete this module and SCIE2101 Module 3 together.

Module 5: Laboratory Techniques and Measurements
Online Manual: Laboratory Techniques and Measurements
Lab Evaluation: Laboratory Techniques and Measurements
Lab Questions #5

In this module the Learner will perform standard laboratory measurements of properties such as length, temperature, mass, volume, and density. The Learner will also use standard laboratory techniques to prepare and dilute solutions of specified concentrations. This module can be completed alongside SCIE2101 Module 4.

Module 6: Stoichiometry of a Precipitation Reaction
Online Manual: Stoichiometry of a Precipitation Reaction
Lab Evaluation: Stoichiometry of a Precipitation Reaction
Lab Questions #6

In this module the Learner will employ the standard method of gravimetric analysis. For a precipitation reaction, the Learner will use reaction stoichiometry to determine the limiting reactant and theoretical yield and quantitatively analyze the product to determine percent yield. This module can be completed alongside SCIE2101 Module 4.

Module 7: Properties of Gases
Online Manual: Properties of Gases
Lab Evaluation: Properties of Gases
Lab Questions #7

In this module the Learner will perform qualitative chemical tests for the presence of various gases. Using the resulting observations, the Learner will categorize and identify gases produced in experimental reactions. This module can be completed alongside SCIE2101 Module 5.

Module 8: pH of Common Materials
Online Manual: pH of Common Materials
Lab Evaluation: pH of Common Materials
Lab Questions #8

In this module, the Learner will explore the concept of pH. The Learner will make pH indicators, use them to measure the pH of common household materials, and compare the results to commercially prepared pH indicators. This module can be completed alongside SCIE2101 Module 8.

Module 9: Determination of Acetic Acid Concentration in Vinegar Using Titration
Investigation Manual: Determination of Acetic Acid Concentration in Vinegar Using Titration
Lab Evaluation: Determination of Acetic Acid Concentration in Vinegar Using Titration
Lab Questions #9

In this module the Learner will employ the standard method of titration to determine an unknown concentration. The Learner will titrate a weak acid with a strong base to determine the concentration of acetic acid in vinegar. This module can be completed alongside SCIE2101 Module 8.

Module 10: Naming of Chemical Compounds
Investigation Manual: Naming of Chemical Compounds
Lab Evaluation: Naming of Chemical Compounds
Lab Questions #10

In this module the Learner will observe and explore the standard systems for naming several types of chemical compounds. The Learner will interpret and name chemical structures of hydrocarbons and binary molecular and ionic compounds. The Learner will also draw chemical structures from names of hydrocarbons and binary molecular and ionic compounds. It is advised to complete this module alongside SCIE2101 Module 9.

III. COURSE READING

Science Interactive (https://www.scienceinteractive.com). *Online Lesson Manual* with lab kit ($100 + shipping), sections as specified for each module.

IV. LEARNING OUTCOMES

Course Learning Outcomes (CLOs)

1. Understand standard approaches for experimentally exploring chemistry (CBULO 1, 2, PCO 1).
2. Apply knowledge of the major concepts within the field of chemistry to experimental results and observations (CBULO 3, PCO 2).
3. Analyze experimental scientific approaches, articulate their underlying assumptions, and distinguish between imbedded inductive and deductive reasoning (CBULO 4, 5, PCO 3, 4).

Bachelor's Program Competency Outcomes (BPCOs)

1. To prepare Learners for roles in transformative education teaching and service.
2. To provide Learners a foundation for effective individual and organizational leadership in diverse environments.
3. To ensure Learners demonstrate worldview foundation for empowering people and building communities.
4. To help Learners formulate a Biblical approach to transformative learning and leadership.

Associate's Program Competency Outcomes (APCOs)

1. To prepare Learners for specialized undergrad study in transformative education theory and in leadership strategies.
2. To provide Learners key worldview foundations for critical thinking and study.
3. To provide Learners with practical experience germane to their transformative learning and leadership.

CBU Learning Outcomes (CBULOs)

1. Critical Thinking, Problem Solving, and Research – Learners will demonstrate ability to think critically, solve problems, and conduct interdisciplinary research at a level appropriate to their program.

2. Personal Growth – Learners will understand how learning is related to personal growth, and will be challenged to grow in their thinking, communication, conduct, and engagement with others.

3. Skills Development – Learners will advance in skills related to their program, demonstrating a level of competency appropriate to their program.

4. Social Responsibility – Learners will appreciate the diversity in and value of others as designed by our Creator, and will grow in willingness and capability to serve others.

5. Worldview Applications – Learners will become capable at thinking from a worldview perspective understanding the relationship of description and prescription, so that they can ground their actions in sound principles.

V. GRADING RUBRIC (1000 POINTS)

Lab Evaluations (60 points each x 9 + 5 points)	545 Points (Short Answer)
Lab Analyses (50 points each x 9 + 5 points)	455 Points (Short Essay)

Lab Evaluations are questions at the end of each lab (answered in the Learner's Science Interactive account) that are based on data collected and observations made while completing the lab. These are designed to assess the Learner's progress in achieving CLOs 1-2. Points for each question are assigned within the Science Interactive gradebook and the overall score is then imported into the Populi assignment.

Lab Analyses are short-essay responses to questions about the general approach to the lab, necessary assumptions, and how it relates to the scientific method. These are designed to assess the Learner's progress in achieving CLO 3 and to stimulate critical worldview-consistent analysis of laboratory science. In some cases, these questions and answers is expected to lead to some back-and-forth exchange of questions and thoughts between the Learner and the mentor.

VI. GRADING SCALE

91-100%	A
81-90%	B
71-80%	C
61-70%	D
0-60%	F

VII. CARNEGIE UNIT CREDIT HOUR EQUIVALENT

Total Hours of Module Content:	5 hours
Total Hours of Reading Content:	5 hours
Total Hours of Lab Experimentation:	20 hours
Total Hours of Lab Evaluations:	5 hours
Total Hours of Lab Analyses:	15 hours

Equivalent of 1 Credit Hour (50 hours of total course time)