SCIE1103 Biology 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 Biology for non-science majors. Learners will gain experience with standard laboratory approaches and techniques such as laboratory safety, the scientific method, microscopy, and simulation / modeling. In addition, the Learner will apply knowledge of biological concepts such as macromolecules, cell types and transport, photosynthesis, genetics, DNA, and taxonomy to experimentally explore scientific questions. The course is designed to be a hands-on supplement to SCIE1101 to equip the Learner with an experiential understanding of and appreciation for the process of exploring biology (and natural sciences in general) with an emphasis on critically analyzing and applying that process.

Module 1: The Scientific Method
Online Manual: Getting Started, Laboratory Safety, The Scientific Method
Lab Evaluation: Getting Started, Laboratory Safety, The Scientific Method
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, setup an at-home lab station, demonstrate an understanding of basic safety practices in the lab, and both identify and apply steps of the scientific method. This module can be completed alongside SCIE1101 Module 1.

Module 2: Introduction to Microscopy
Online Manual: Using the V-Scope, Introduction to Microscopy
Lab Evaluation: Using the V-Scope, Introduction to Microscopy
Lab Questions #2

In this module the Learner will become familiar with the components of an optical microscope (virtually), apply concepts of magnification to calculate the total magnification and field of view for the lenses of the microscope, and examine prepared slides with the 4x, 10x, and 40x objective lenses. This module can be completed alongside SCIE1101 Module 1.

Module 3: Biological Macromolecules
Online Manual: Biological Macromolecules
Lab Evaluation: Biological Macromolecules
Lab Questions #3

In this module the Learner will apply knowledge of biological macromolecules and their indicators to be able to identify their presence. The Learner will perform qualitative tests to determine the presence of sugars, starch, proteins, and lipids using Benedict's reagent, Lugol's iodine, Biuret's reagent, and Sudan III. The Learner will also identify the macromolecular composition of an unknown biological macromolecule. This module can be completed alongside SCIE1101 Module 1.

Module 4: Cell Types: Structure and Function
Online Manual: Cell Types: Structure and Function
Lab Evaluation: Cell Types: Structure and Function
Lab Questions #4

In this module the Learner will apply knowledge of cell types to observe and categorize cells. The Learner will review the composition of cells by digitally constructing models of prokaryotic and eukaryotic cells, examine prepared slides of various types of cells (plant, human, protist, and bacteria), and identify components of cells viewed under a microscope. This module can be completed alongside SCIE1101 Module 2.

Module 5: Cell Membrane Transport
Online Manual: Cell Membrane Transport
Lab Evaluation: Cell Membrane Transport
Lab Questions #5

In this module the Learner will apply the principles of osmosis to model cell membrane transport. The Learner will determine the tonicity of sucrose solutions relative to potato slices by measuring the extent of osmosis and examine diffusion across selectively permeable dialysis tubing. This module can be completed alongside SCIE1101 Module 3.

Module 6: Photosynthesis
Online Manual: Photosynthesis
Lab Evaluation: Photosynthesis
Lab Questions #6

In this module, the Learner will apply knowledge of photosynthesis to measure its rate. The Learner will measure the effects of light and carbon on the rate of photosynthesis in spinach leaf discs. In addition, the Learner will perform paper chromatography to separate pigments within a spinach leaf. This module can be completed alongside SCIE1101 Module 4.

Module 7: Mendelian Genetics
Online Manual: Mendelian Genetics
Lab Evaluation: Mendelian Genetics
Lab Questions #7

In this module the Learner will apply knowledge of Mendelian genetics to examine traits of millet seeds and corn. The Learner will create Punnett squares for both monohybrid (millet seeds) and dihybrid (corn) crosses, describe the relevant phenotypes and genotypes, and analyze the results of the crosses via Chi-square tests. This module can be completed alongside SCIE1101 Module 6.

Module 8: DNA, RNA, and Protein Synthesis
Online Manual: DNA, RNA, and Protein Synthesis
Lab Evaluation: DNA, RNA, and Protein Synthesis
Lab Questions #8

In this module the Learner will strengthen knowledge of DNA, RNA, and protein synthesis via an interactive illustration of protein formation through transcription and translation. The Learner will simulate the transcription and translation steps as well as the generation of point and frameshift mutations. It is recommended that this module be completed alongside SCIE1101 Module 7.

Module 9: Population Genetics: Natural Selection and Hardy-Weinberg Equilibrium
Investigation Manual: Population Genetics: Natural Selection and Hardy-Weinberg Equilibrium
Lab Evaluation: Population Genetics: Natural Selection and Hardy-Weinberg Equilibrium
Lab Questions #9

In this module the Learner will apply knowledge of population genetics to model and analyze genetic drift and natural selection. The Learner will use random sampling of different colored beans to model genetic drift, modify the sampling process to model natural selection, compare the results to predicted results, and critically analyze both processes. This module can be completed alongside SCIE1101 Module 8.

Module 10: Taxonomy
Investigation Manual: Taxonomy
Lab Evaluation: Taxonomy
Lab Questions #10

In this module the Learner will apply knowledge of biological classification to identify organisms and generate a classification scheme. The Learner will examine unknown protists under an optical microscope in order to identify them based on a given dichotomous key for microorganisms. The Learner will then create a dichotomous key for eight leaf types given their names and images. This module can be completed alongside SCIE1101 Module 9.

III. COURSE READING

Science Interactive (https://www.scienceinteractive.com). *Online Lesson Manual* with lab kit ($109 + shipping), sections as specified for each module.

IV. LEARNING OUTCOMES

Course Learning Outcomes (CLOs)

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

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 (55 points each x 10)	550 Points (Short Answer)
Lab Analyses (45 points each x 10)	450 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.

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 are expected to lead to some back-and-forth exchange of questions and thoughts between the Learner and the course 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:	25 hours
Total Hours of Lab Evaluations:	5 hours
Total Hours of Lab Analyses:	10 hours

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