

**Title: Mysliwec- Analysis of Halosimplex carlsbadense: A molecular approach
B M B 442 Laboratory in Proteins, Nucleic Acids, and Molecular Cloning (3)**

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Type of Manuscript: *CourseSource* Lesson Manuscript

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List of Tables, Figures and Supplemental Material: Please list the Figures, Tables and Supplemental materials associated with the Lesson.

Title and Description of Primary Image: We ask that an image be submitted with the manuscript that represents the information in the article (e.g. a picture of a dividing cell for a Lesson about mitosis or a picture taken of students doing the activity). This image will be displayed with the title of your article on the *CourseSource* website. If you do not have a primary image, the editorial staff will select one that best fits your article. Please be conscientious of the copyright associated with any image used in your Lesson!

Abstract Page

*With a growing undergraduate student body in our biology and biochemistry majors not enough undergraduate research spots available and a societal demand for trained scientists our department saw a need for a technical lab course that offered an authentic research experience that ties genotype to phenotype to senior students not already working in a research laboratory. These students will be enrolled in a 3credit lab course. A partial immersion program that will require students enrolled in BMB442 to spend 10-12 hours a week working on their project (in classroom, computer room or teaching lab). The goal of this program is to create for senior level students who have not been exposed to undergraduate research through independent study, co-op or internship an opportunity to obtain experience working in a research setting. Students enrolled in this course will participate in a collaborative research investigation of the genes on *Halosimplex carlsbadense*. Students will design a series of molecular biology experiments that include, primer design, PCR amplification, cloning, gene expressions and protein analysis in a semester long genotype to phenotype project. Students will also explore the cross-disciplinary nature of bioinformatics and genomics.*

The abstract should be a single paragraph of 250 words or less. Start with an opening sentence that sets the teaching challenge that you address in this manuscript, provide background information specific to this Lesson, briefly description the Lesson, and end with a concluding sentence.

Article Context Page: To make the submission process easier, you may want to fill out the following form, (you will be asked to select answers during the submission process). Choose all applicable options that effectively describe the conditions **IN WHICH THE LESSON WAS TAUGHT**. Modifications to expand the usability of the Lesson will be addressed later in the text.

Course

Biochemistry
Cell Biology
Genetics
Microbiology
Molecular Biology

Course Level

Upper Level

Class Type

Lab
Discussion Section

Audience

4-year College
University

Class Size

1 – 12

Lesson Length

One term (semester or quarter)

Key Scientific Process Skills

Reading research papers
Reviewing prior research
Asking a question
Formulating hypotheses
Designing/conducting experiments
Predicting outcomes
Gathering data/making observations
Analyzing data
Interpreting results/data
Displaying/modeling results/data
Communicating results

Pedagogical Approaches

Think-Pair-Share
Collaborative Work
Reflective Writing- poster, integration paper, lab reports
Computer Model
Physical Model
Interactive Lecture
Pre/Post Questions- quizzes
Other

Bloom's Cognitive Level (based on learning objectives & assessments)

Foundational: factual knowledge & comprehension

Application & Analysis

Synthesis/Evaluation/Creation

Principles of how people learn

Motivates student to learn material

Focuses student on the material to be learned

Develops supportive community of learners

Leverages differences among learners

Reveals prior knowledge

Requires student to do the bulk of the work

Vision and Change Core Concepts

Evolution

Structure and Function

Information flow, exchange and storage

Pathways and transformations of energy and matter

Systems

Vision and Change Core Competencies

Ability to apply the process of science

Ability to use quantitative reasoning

Ability to use modeling and simulation

Ability to tap into the interdisciplinary nature of science

Ability to communicate and collaborate with other disciplines

Ability to understand the relationship between science and society

Key Words: List 3 – 10 key words that are relevant for the Lesson (e.g. mitosis; meiosis; reproduction; egg; etc.)

1. Integrated Bioinformatics
2. Cloning and gene expression
3. Undergraduate research experience

Scientific Teaching Context Page

Learning Goal(s): Provide clearly stated learning goals, which are broad statements of what the students will know once they have completed the Lesson. Learning goals are typically rather abstract and use words like “know,” “understand,” “appreciate,” or “demonstrate”.

- *Provide students with an authentic research experience by introducing students to the fields of microbial genomics and bioinformatics*

Become familiar with some tools and techniques used in bioinformatic field by surveying genes on assembled/annotated genome (*Halosimplex carlsbadense*), picking a gene of interest (known function and assay design).

- *Students will understand the process of gene expression*

Pick a gene of interest, design primers, amplify, clone into expression vector, analyze transformants, analyze expressed protein for structure and function.

- *Students will develop an appreciation for the interdisciplinary nature of the field of genomics and bioinformatics.*

Learning Objective(s): Define what students who have successfully accomplished the learning goal can actually do. Learning objectives describe student behaviors that are observable, measurable, and testable. Learning objectives should test students’ mastery of the material and use words like “define”, “predict”, “design” and “evaluate.”

- *Students will design a series of molecular biology experiments that include, primer design PCR amplification, cloning, gene expression analysis*

- *Students will discuss, evaluate and reflect on data from primary literature papers*

students will read papers throughout the course

Research papers to discuss and review techniques and theory

Research papers to discuss the integration of bioinformatics/genomics in diverse fields...microbial ecology, cancer research, organismal biology, space.

- *Students will present the results of their project in a poster format*

Main Text

Begin the Lesson text on a new page. Include the following sections:

1. Introduction: The introduction should provide the origin and rationale for the design of the Lesson and provide enough background information to allow the reader to evaluate the Lesson without referring to extensive outside material. For complex topics, a Science Behind the Lesson article may be simultaneously submitted with the Lesson, so that potential instructors will have sufficient information to implement the Lesson.

The introduction should also explain:

Intended Audience:

Sr level majors - Biology/Biochemistry

Learning time:

Semester long laboratory project

Weeks 1-3 Introduction

Project introduction

Review microbiology, genetics, biochemistry, bioinformatic tools

Lab safety and practice and research gene of interest

Mini-presentations

Students present their gene to class - outline their approach and justify their choice

Weeks 4-7 Primer design, amplification and cloning

Primer design - primary literature about approaches to primer design and programs for design

PCR - review and develop protocol

Clone - TOPO cloning

Weeks 8-10 Protein purification and expression

Review techniques for protein purification, western blot analysis

Induce proteins and quantitate yield

Weeks 11-14 Protein function and analysis

Week 15 Wrap-up - presentations

Pre-requisite student knowledge:

This activity assumes limited but some skill level and content knowledge. Junior/senior level lab, students have completed cell biology, organic chemistry both lecture and lab.

2. Scientific Teaching Themes: Explain how the Lesson relates to the Scientific Teaching Themes of:

Active Learning:

How will students actively engage in learning the concepts? List and/or explain the active learning strategies that are used in the Lesson. For example, activities could include think-pair-share, clicker questions, group discussion, debate, etc. Include both in-class and out-of-class activities.

Assessment: How will teachers measure learning? How will students self-evaluate their learning? List and/or explain the kinds of assessment tools used to measure how well students achieved the learning objectives. For example, assessments might be clicker questions, forced choice questions, exams, posters, etc.

Inclusive Teaching: How is the Lesson designed to include all participants and acknowledge the value of diversity in science? List and/or explain how the Lesson is inclusive and how it leverages

diversity in the classroom and beyond. For example, the lesson may use multiple senses and provide examples of scientists from different backgrounds.

3. Lesson Plan: Provide a detailed description of the Lesson that is sufficiently complete and detailed to enable another teacher to replicate it. You may need/want to include subsections such as: pre-class preparation and in-class script. **A Table containing a recommended timeline for the class should be included.** As needed, expand upon aspects of scientific teaching that are particularly highlighted in the Lesson. As appropriate, provide examples of formative and/or summative assessments and related rubrics. List materials that are necessary or useful for teaching the Lesson, whether they are provided as supplementary materials or as links to other websites.

4. Teaching Discussion: Share your observations about the Lesson's effectiveness in achieving the stated learning goals and objectives, student reactions to the Lesson, and your suggestions for possible improvements or adaptations to different courses or student populations.

Subheadings: can be included within the sections above to increase readability and clarity.

Acknowledgments
GCAT-SEEK

References

Begin the References on a new page.

* Cite references in the text using superscript Arabic numbers. Use commas to separate multiple citation numbers. Superscript numbers are placed outside periods and commas and inside colons and semicolons

Begin the reference list on a new page. The reference list is comprehensive and spans the text, figure captions and materials.

Number references in the order in which they appear in the text. Follow [ASM style](#) and abbreviate names of journals according to the journals list in [NCBI](#). List all authors and/or editors up to 6; if more than 6, list the first 3 followed by "et al." Note: Journal references should include the issue number in parentheses after the volume number.

Examples of reference style:

Knight JK, Wood WB. 2005. Teaching more by lecturing less. *Cell Biol Educ.* 4(4):298-310.

Samford University. How to get the most out of studying: A video series.
www.samford.edu/how-to-study/. Accessed August 20, 2013.

Handelsman J, Miller S, Pfund C. 2006. *Scientific Teaching*. New York, NY:W.H. Freeman.

Figure and Table

* The actual figures, tables, and supplemental materials are uploaded as separate documents and should not be included in this text file.

Tables: Table 1. Table legends should contain a short description of the table.

Figures: Figure 1. The figure legend should begin with a sentence that describes the overall “take home message” of the figure. Figure parts are indicated with capital letters (A).

Supplementary Materials: