Assessment of Student Learning Plan (ASLP): Biology Department

2014-15 Academic Year

A. College, Department/Program, Date

College	*CSTH*
Department/Program	Biological Science
Date	*June 10, 2015*

B. Contact Person for the Assessment Plan

Name and title *Jeffrey Walker, Chair, Biological Sciences*

C. Degree Program

Name of Degree Program *B.S. Biology*

D. Assessment of Student Learning in Your Program

Step 1: Identify Student Learning Outcomes (What are students able to do by the end of your program?)

a. *List 3-5 of the most important student learning outcomes for your program.*
b. *Then, identify which student learning outcomes were assessed this past academic year. (One or more of the outcomes and corresponding assessment plans could come from your department's CORE Course Blueprint(s).*

Learning Goal 1. Foundations

Our graduates will have a basic understanding of the expansive field of modern biology, from molecules to ecosystems. In addition, they will understand the basic principles of chemistry, physics, and mathematics that form the foundation on which all of biology rests.

Learning objectives for Goal 1

1. Students will gain a basic understanding of biochemistry, cell, molecular and developmental biology, genetics, evolution, biodiversity and systematics, ecology, and whole organism physiology of plants and animals.

2. Students will have a basic understanding of the foundational sciences of physics and chemistry necessary to grasp biological concepts.

3. Students will be able to understand and employ mathematical concepts used in biology, such as statistics and probability for genetics and calculus for population growth.

4. Students will appreciate the incredible range of the field of biology and will become acquainted with various career options available to a person with a degree in the biological sciences.

Learning Goal 2. Evolution

Our graduates will have a firm understanding of the process of evolution by natural selection. Because evolution is understood as the broad integrating theme of all biology, explaining both its unity and diversity and linking all aspects both future and past, we expect students to have both deep and broad knowledge of its mechanisms and implications.

Learning objectives for Goal 2

1. Students will have knowledge of the history of evolutionary thought, from Charles Darwin to Christiane Nusslein-Volhard.

2. Students will understand and be able to explain concepts of microevolution, including natural selection and population genetics. They will grasp how both traditional and modern molecular methods are used for elucidating changes in populations over time.

3. Students will understand macroevolution, including the history of life on Earth and various techniques used to illuminate these relationships, from geography and geology to modern genetic techniques.

4. Students will gain in-depth knowledge of how modern genetics and genomics have corroborated the ideas of evolutionary biology and added to mechanistic underpinnings.

5. Students will directly address and correct their own misconceptions about evolution and natural selection.

6. Students will become acquainted with the vast trove of scientific research on evolution, including studies that reveal evolution in real time.

7. Students will gain the knowledge and confidence to explain the mechanisms of evolution and relay the unequivocal support that the fact of evolution enjoys within the international scientific community.

Learning Goal 3. Genetics

Our graduates will acquire detailed knowledge of genetics, including its mechanisms, history, and societal implications. In addition, students will understand how modern genetics impacts many facets of society.

Learning Objectives for Goal 3

1. Students will know the history of genetics, from Mendel to the present.

2. Students will understand and employ basic concepts of Mendelian genetics and the chromosomal basis of inheritance.

3. Students will grasp the revolutionary discovery of DNA as the genetic material, and they will broadly comprehend how DNA illuminates not only how organisms perpetuate themselves, but also how organisms function. This includes detailed knowledge of DNA replication, transcription, translation, and regulation of gene expression.

4. Students will understand techniques used in modern genetics laboratories, including recombinant DNA techniques, gel electrophoresis, cloning, PCR, genetic engineering and transgenic systems.

5. Students will gain an informed and nuanced understanding of modern biotechnology, its goals and promise, as well as ethical problems presented by this field.

6. Students will understand how the modern fields of genetics and genomics have illuminated other fields of biology, particularly systematics and medicine.

Learning Goal 4. Specialization

Our graduates will demonstrate specialized knowledge in some area(s) of biology, where they will become acquainted with both classic and cutting edge research in the fields. This goal dovetails with aspects of Goal 1 as it seeks to solidify the basic knowledge component that students acquire in earlier courses.

Learning Objectives for Goal 4: General Biology Concentration

Students concentrating in General Biology will gain specialized knowledge in three areas of Biology: Organismal Biology, Ecology, and Cellular and Functional Biology.

Organismal Biology Area

1. Students will become acquainted with a subset of organisms within the three Domains of Life and understand what characterizes Bacteria, Archaea, Protist groups, Fungi, Plants or Animals.

2. Students will gain extensive knowledge of the structure of organisms falling within the particular group of study, especially with respect to traits used for classification.

3. Students will gain in-depth knowledge of the evolutionary history of a particular group of organisms (insects, parasites, invertebrates, or plants) elucidated by fossil, morphological, and anatomical data.

4. Students will be exposed to modern methods employed in systematics, particularly molecular methods and cladistics, and to some extent be able to employ these methods themselves.

5. Students will be able to identify Maine representatives of the group they choose to study, and they will be confident in their ability to use sources to identify unknown members of this group.

6. Students will appreciate how new developments in genetics and genomics are elucidating evolutionary relationships among organisms, clearing up centuries-old questions about phylogenetic histories.

Ecology Area

1. Students will appreciate the variation in how organisms adapt to different environmental conditions (morphologically, physiologically, and behaviorally), given evolutionary constraints.

2. Students will understand and be able to quantify how populations grow and shrink over time and how the evolution of life history traits influences rates of population increase and decrease.

3. Students will know how populations interact with each other in ecological communities and how these interactions influence the structure of communities over ecological and evolutionary time.

4. Students will understand where ecological communities occur on Earth, what climatic features maintain them, how ecological communities develop, ways to describe them, and how they are maintained or recover in response to perturbations.

5. Students will understand how energy flows and nutrients cycle among different components of ecosystems and the critical role that microbes play in biogeochemical cycles on Earth.

6. Students will become familiar with the large body of research that addresses anthropogenic global change and be able to explain how scientists know why these factors currently impact and will continue to impact the world's ecosystems.

Cellular and Functional Biology Area

1. Students will have a detailed understanding of the dynamics that occur inside cells, including metabolism, gene expression, membrane dynamics, signaling pathways, and mechanisms of cell motility.

2. Students will understand and be able to create visible representations of cell organization and structure.

3. Students will gain in-depth knowledge of cellular and molecular biology with an evolutionary perspective within a particular area such as microbiology or neurobiology.

4. Students will be introduced to modern experimental tools used in cellular and molecular biology research.

5. Students will understand mechanisms of various diseases in organisms, such as bacterial and fungal diseases and cancer.

Learning Objectives for Goal 4: Human Biology Concentration

Students concentrating in Human Biology will gain in depth knowledge of cell biology, anatomy, and physiology of humans. Students will take at least three advanced courses in the Cellular and Functional Biology Area and will take additional upper level courses in Chemistry.

Learning Objectives for Goal 4: Biotechnology Concentration

Students concentrating in Biotechnology will gain both knowledge and skills of cell and molecular biology so they are poised to either go to graduate school or become employed in biotechnology firms. Biotechnology students will also have the opportunity to take graduate courses in Applied Medical Sciences that further solidify a modern approach to human biology.

Learning Goal 5. Lab and Field Skills

Our graduates will be able to employ common lab or field techniques used by biological scientists and will therefore be prepared for employment in government and private laboratories, hospitals, classrooms, nonprofits, and consulting firms.

Learning Objectives for Goal 5

1. Students will understand principles of the scientific approach of generating a hypothesis, testing that hypothesis, refining the hypothesis and testing it further.

2. Students will understand the basics of experimental design, including the need for random sampling and repetitions and the need to have controls for valid experiments.

3. Students will obtain basic laboratory and field skills, such as pipetting, using various small instruments (e.g., microscopes, balances, spectrophotometers, and vortexers), making and diluting solutions, quantifying dominance and diversity, and using dichotomous keys.

4. Students will collect experimental and observational data, analyze the data in some statistical format, and describe the results in graphical form.

5. Students will have knowledge of basic lab and field safety.

Learning Goal 6. Scientific communication

Our graduates will become adept at scientific communication, perfecting their abilities to communicate scientific findings to both peer and lay audiences. They will aspire to serve as ambassadors of science to educate and impact the public.

Learning objectives for Goal 6

1. Students will be capable of researching a topic in biology and integrating the primary literature into a coherent whole.

2. Students will perfect their writing skills from entry level through advanced courses.

3. Students will be competent at presenting their own biological findings to peers and to lay audiences.

4. Students will be capable of deconstructing complex biological topics and translating them without loss of content to lay audiences.

5. Students will be able to use their knowledge base and skills of communication to converse with and potentially impact policy makers, the public, and individuals.

Learning Goal 7. Scientific Worldview

Our graduates will adopt a scientific worldview, leading them to be both curious and skeptical of new information. They will be concerned with the societal implications of science and the impacts of society on the natural world.

Learning Objectives for Goal 7

1. Students will remain life-long learners in biology, made easier because they have the necessary context in which to place future biological discoveries.

2. Students will understand the nature of science and how the scientific enterprise moves forward, by comprehending the rigor of the peer review process and understanding how elimination of hypotheses leads to an understanding of biological phenomena.

3. Students will be able to critically evaluate scientific claims by researching both the primary and secondary literature, and they will be capable of forming their own knowledge based conclusions about scientific work. They will demand evidence before accepting statements as fact and will be able to hypothesize about future research.

4. Students will have experience grappling with ethical issues surrounding topics such as stem cell research, loss of biodiversity, and evolution education, and they will be able to back up their positions with knowledge about the science.

Step 2: How and When were the Learning Outcomes assessed?

a. *Briefly describe the assessment tools, measures, or forms of evidence that were utilized to demonstrate students' accomplishment of the learning outcomes selected.*

We give no comprehensive exam. Most of our learning goals are assessed in individual classes using quizzes, exams, posters presentations, oral presentations, lab reports, papers, and specific assignments related to software and hardware technologies.

In our capstone classes we assess several of the overall learning goals by asking students to read, present, and discuss papers from the primary literature. This addresses:
1. Depth of knowledge in biology, which is necessary to comprehend a complex research study (Learning goals 1- 4)
2. Depth of knowledge in chemistry, physics, and/or statistics, which are often intertwined with particular research studies (Learning goal 1)
3. Ability to integrate the lab and field skills acquired up to this point, in particular to critically assess research methodology and data analysis (use of Learning goal 5)
4. Ability to formally present research studies in an organized coherent manner and to participate in thoughtful, respectful discussions (Learning goal 6)
5. Ability to critically analyze research studies, both the in-depth methodology and the fit in a larger world context (Learning goal 7)

b. *Briefly describe when and how you implemented the assessment activity.*

Assessment occurs continuously through all classes, both fall and spring. Our capstone classes are offered in both fall and spring.

Step 3: Process of Using the Assessment results to Improve Student Learning

a. *Briefly describe your unit's process of reviewing the program assessment results, and how you expect to improve student learning.*

Faculty continuously review results for individual classes and make adjustments to pedagogical strategies. We discuss these results at faculty meetings and have modified the curriculum in response to encourage better sequencing. These discussions allow pedagogical ideas that address the learning outcomes that we've established to flow between faculty and courses.

E. Are there "community engagement" activities integrated in your departmental curriculum?

a. Please indicate which of the components, listed below, are <u>included</u> in your program's curriculum, and then indicate if the activities are <u>required or optional</u> for students in your major.

Community Engagement Activity	*Included*	*Required/Optional*
Student Research (related to a community-based problem)	Yes	O
Student-Faculty Community Research Project	Yes	O
Internship, or a Field Experience	Yes	O/R
Independent Study (community-related project)	Yes	O
Capstone Course (community-related project)	Yes	R
Service-Learning (a component of a course)	Yes	O
Study Abroad, or an International Program	No	
Interdisciplinary Collaborative Project (community related)	No	
Student Leadership Activities (related to a team project)	No	
Students/Faculty Community Leadership (advisory boards, committees, conference presentations)	No	

Other Activities (not mentioned above):

b. Please list the courses (i.e. EDU 400) that have a "community engagement" activity in your program:

Entry-level courses:

Mid-level courses: BIO 281, 282 (Microbiology); Bio 231 (Botany)

Upper-level courses: BIO 311 (Microbiology), BIO 353 (Vertebrate Zoology), BIO 415 (Microbial Ecology)