Program Assessment Plan

Bachelor of Science in Biology
Bachelor of Science in Marine Biology
University of Alaska Southeast

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I. Degree Title

Bachelor of Science in Marine Biology, University of Alaska Southeast
Bachelor of Science in Biology, University of Alaska Southeast

II. Student Assessment

A. Student Learning Goals

The Marine Biology faculty have worked together to develop the Bachelor of Science in Marine Biology curriculum which provides a solid foundation for students in biology with a strong core in marine biology. It is a rigorous curriculum that produces graduates ready to gain employment or pursue graduate study in the field. The B.S. in Marine Biology is designed to serve the needs of three groups of undergraduate students. First, it is directed toward students preparing to enter graduate school in the fields of oceanography, marine biology, ecology, evolutionary biology, and fisheries. Second, it is designed to serve students seeking entry-level employment in the fields related to marine biology, including positions at state and federal agencies. Third, it is designed to serve students preparing to enter the M.A.T. program in secondary education at UAS and thus reflects the requirements for certification in science. The B.S. in Marine Biology is designed to capitalize on the unique natural setting and natural resources in Southeast Alaska. Many of the courses involve hands-on field and laboratory exercises. Research with a faculty mentor is encouraged.

Specific learning goals include the following.

1. The graduate will master fundamentals of biological science.
2. The graduate will understand fundamentals of mathematics, statistics, chemistry and physical sciences and how they relate to biological science.
3. The graduate will master fundamentals of marine biology.
4. The graduate will master an in-depth study of organismal-level biology.
5. The graduate will master an in-depth study of a core in marine biology.

B. Student Outcomes

Specific outcomes for each of these goals include the following. For a more detailed listing of courses and outcomes, see the Marine Biology program curriculum map in Section IV.

Goal 1. The graduate will master fundamentals of biological science through:

1. Understanding and articulation of content areas (i.e.: mechanisms of evolution, chemical processes of life, biological diversity, and genetics) pertaining to Biology.
2. Understanding and articulation of terminology (i.e. DNA transcription, specific taxonomy) specific to Biology.
3. Understanding through laboratory exercises contemporary techniques employed in the field (i.e.: PCR, electrophoresis, chromatography, and data analysis)

Goal 2. The graduate will understand fundamentals of mathematics, statistics, chemistry and physical sciences and how they relate to biological science through:

1. Understanding the content areas specific to these disciplines.
2. Integrating the fundamentals of mathematics, statistics, chemistry and physical sciences into higher level program courses.

Goal 3. The graduate will master fundamentals of marine biology

1. Understanding and articulation of content areas (i.e.: oceanography, chemical processes of life, intertidal diversity) pertaining to Marine Biology
2. Understanding and articulation of the terminology (i.e. DNA transcription, specific taxonomy) specific to Marine Biology
3. Understanding through laboratory exercises contemporary techniques employed in marine related fields of biology (plankton sampling, invertebrate identification, and computer modeling)

Goal 4. The graduate will master an in-depth study of organismal-level biology.

1. Understanding and articulation of the major principals of ecology
2. Understanding and articulation of the major principals of animal physiology
3. Understanding and articulation of the major principals of genetics
4. Understanding and articulation of the major principals of evolution

Goal 5. The graduate will master an in-depth study of core concepts in marine biology

1. Understanding and articulation of taxonomic diversity expressed courses such as invertebrate zoology, ichthyology, marine mammalogy, and phycology
2. Understanding and articulation of the major principals of physiology of marine organisms
3. Understanding and articulation of the major principals of marine ecology

C. UAS Competencies

The following competencies will be integrated into the program through achievement of the student learning goals as follows:

	Goal One	Goal Two	Goal Three	Goal Four	Goal Five
Communication Written Oral	X	X	X	X	X
Quantitative Skills	X	X	X	X	X
Information Literacy	X		X	X	X
Computer Literacy	X	X	X	X	X
Professional Behavior	X	X	X	X	X
Critical Thinking	X	X	X	X	X

III. Relevance to the University Mission

The B.S. in Marine Biology supports the university's goal of being the premier in-state campus for marine science undergraduate programs. Specifically, the B.S. in Marine Biology furthers the following core values of the UAS mission/strategic plan:

- Achieving distinction as a learning community
- Developing programs rooted in its unique natural setting.
- Developing educated citizens with a sense of personal ethics
- Contributing to the economic development of the region and the state through basic and applied research and public service
- Forging dynamic partnerships with other academic institutions, governmental agencies and private industry

IV. Curriculum Map

The Marine Biology faculty have worked together and agree that the following goals are introduced (I), developed (D) and mastered (M) at the following points in the program:

A. Map

	BIOL 105	BIOL 106	BIOL 215	BIOL 271	BIOL 310	BIOL 362	BIOL 482
Goal 1.							
Outcome 1.	I	I	D	D	M	M	M
Outcome 2.	I	I	I	D	D	D	M
Outcome 3.	I	I	I	D	D	D	M
Goal 2.							
Outcome 1.	I	I		D	D	D	
Outcome 2.	I	I		D	D	D	M
Goal 3.							
Outcome 1.			I	D	D	D	
Outcome 2.			I	D	D	D	
Outcome 3.				I	I	D	
Goal 4.							
Outcome 1.				M			
Outcome 2.					M		
Outcome 3.						M	M
Outcome 4.							M
Goal 5.							
Outcome 1.	I	I	D	D	D	D	
Outcome 2.	I	I	D	D	D		
Outcome 3.	I	I	D	D			

	BIOL 305	BIOL 384	BIOL 401	BIOL 415	BIOL 481	BIOL 300	BIOL 239
Goal 1.							
Outcome 1.	D	D	M	M	M	D	I
Outcome 2.	D	D	M	M	M	D	D
Outcome 3.		D	D	M	M		
Goal 2.							
Outcome 1.				M	M		
Outcome 2.				M	M		
Goal 3.							
Outcome 1.	D	D	D		M	D	
Outcome 2.	D	D	D				D
Outcome 3				M	M		
Goal 4.							
Outcome 1.	D	D	D	D	D	D	D
Outcome 2.				M			
Outcome 3							
Outcome 4.	D	D	D			D	D
Goal 5.							
Outcome 1.	M		M				
Outcome 2.		M					
Outcome 3							

	BIOL 375	BIOL 396	BIOL 426	BIOL 427	BIOL 441	BIOL 480	BIOL 492
Goal 1.							
Outcome 1.	D	D	D	D	D	D	
Outcome 2.	D	D	M	D	M	M	D
Outcome 3.		M	M				
Goal 2.							
Outcome 1.		D				D	D
Outcome 2.		D				M	D
Goal 3.							
Outcome 1.	D	D	D	D	D	D	D
Outcome 2.	D		D	D	D	M	D
Outcome 3.		M	D	D	D		

	BIOL 375	BIOL 396	BIOL 426	BIOL 427	BIOL 441	BIOL 480	BIOL 492
Goal 4.							
Outcome 1.		D	M	M	M		D
Outcome 2.			D	D		D	
Outcome 3.						D	
Outcome 4.	D	D	M	M	M		D
Goal 5.							
Outcome 1.	D	D	M	M	M	M	D
Outcome 2.		D	D	D			
Outcome 3.	D	D	D	D	D	M	

	BIOL 495	BIOL 498
Goal 1.		
Outcome 1.	D	D
Outcome 2.	D	D
Outcome 3.		M
Goal 2.		
Outcome 1.		D
Outcome 2.		M
Goal 3.		
Outcome 1.		D
Outcome 2.	M	
Outcome 3.		M
Goal 4.		
Outcome 1.	M	D
Outcome 2.	M	D
Outcome 3.		
Outcome 4.	M	D
Goal 5.		
Outcome 1.	D	D
Outcome 2.		
Outcome 3.	D	D

B. Syllabi: Sample program syllabus which indicates where program goals are mapped is attached in Appendix A.

V. Learning Outcomes Assessment Methods and Measures

A. Entrance Assessment

All students at UAS are required to take placement tests in reading, writing, and mathematics. Developmental courses are available for students who score below the college level in these areas. The Fundamentals of Biology course sequence required of all pre-majors provides the basic concepts common to all biological fields in addition to an initial exposure to the scientific method, scientific writing and the peer-reviewed scientific literature.

B. Learning Outcomes by Course Level

The following descriptions serve as learning outcomes for sophomore-, junior-, and senior-level course in the B.S. program in Marine Biology. These guidelines serve as a rubric for developing and implementing the program curriculum.

1. Sophomore-Level Courses

Sophomore-level courses introduce the content area within Biology and do not require advanced knowledge from other scientific areas (e.g. Chemistry). Course content includes terminology specific to Biology as well as techniques employed in the field.

Students who pass a sophomore-level course will have a basic foundation of knowledge in the course topic. They will have begun to acquire familiarity with library resources, both print and electronic.

2. Junior-Level Courses

In junior-level courses, course content assumes an increasing level of prior knowledge about the field of Biology. In this respect, course content may be more specific than that offered on the sophomore level. Course content may require advanced study in Biology or other scientific areas (e.g. Chemistry).

Students who pass a junior-level course have demonstrated an ability to master both theoretical and practical concepts in Biology. Students should be able to demonstrate an increasingly sophisticated use of library resources and should be able to access the primary scientific literature independently. Students take on increasing responsibility for contributing to and shaping class discussions. Students will have had practice in verbally presenting their work to an audience of peers.

3. Senior-Level Courses

Senior-level courses are specific in content, assuming a base of prior knowledge in the field that is both broad and fairly detailed.

Students who pass a senior-level course have demonstrated the ability to master detailed information as well as the ability to think critically and evaluate scientific information. Students at this level will demonstrate the highest level of proficiency in utilizing library resources; their work will include proper and sophisticated use of documentation and references for research and documentation. They will have taken a leadership role when contributing to class discussion and in presenting their work orally to their peers.

VI. Program Assessment Methods and Measures

A. The Biology Student Assessment Coordinator will facilitate program assessment based on the following:

- Surveying graduating seniors during an exit interview. The questions for the exit interview are included in Appendix B.
- Tracking student success in grade point average.
- Tracking student retention.
- Tracking student success through graduate employment
- Tracking student success through acceptance in graduate school
- Meeting annually with the Marine Biology Advisory Committee to summarize achievements and discuss goals.

B. Rubric – Student Levels of Proficiency

Use of this rubric will enable the Biology Student Assessment Coordinator to effectively aggregate and summarize student data in regard to student learning goals and outcomes. Overall

Rating Scale:
Exceeds Expectations 1 = exemplary performance
Exceeds Expectations 2 = surpasses the standards and performance expectations
Meets Expectations 3 = very good performance; consistently meets standards and performance expectations
Meets Expectations 4 = good performance; generally meets standards and performance expectations
Does not meet expectations 5 = performance does not meet expectations; below expected levels; improvement needed
Does not meet expectations 6 = performance falls below expectations; substantial improvement critical

Goal 1. The graduate will master fundamentals of biological science.

	Exceeds Expectations		Meets Expectations		Does Not Meet Expectations	
	1	2	3	4	5	6
Outcome 1.						
Outcome 2.						
Outcome 3.						

Goal 2. The graduate will understand fundamentals of mathematics, statistics, chemistry and physical sciences and how they relate to biological science.

	Exceeds Expectations		Meets Expectations		Does Not Meet Expectations	
	1	2	3	4	5	6
Outcome 1.						
Outcome 2.						

Goal 3. The graduate will master fundamentals of biology/marine biology.

	Exceeds Expectations		Meets Expectations		Does Not Meet Expectations	
	1	2	3	4	5	6
Outcome 1.						
Outcome 2.						
Outcome 3.						

Goal 4. The graduate will master an in-depth study of organismal-level biology.

	Exceeds Expectations		Meets Expectations		Does Not Meet Expectations	
	1	2	3	4	5	6
Outcome 1.						
Outcome 2.						
Outcome 3.						
Outcome 4.						

Goal 5. The graduate will master an in-depth study of a core in biology/marine biology.

	Exceeds Expectations		Meets Expectations		Does Not Meet Expectations	
	1	2	3	4	5	6
Outcome 1.						
Outcome 2.						
Outcome 3.						

VII. Assessment Cycle

A. Schedule: A reassessment of program needs/improvements will be conducted on a regular basis, including an annual review of curricular concerns. This will be conducted during the annual UAS convocation in August of each year. This will enable faculty from the three regional campuses to discuss, evaluate and make programmatic changes in response to data collected. Program faculty will meet annually with a Biology Advisory Committee at the end of each academic year.

B. Procedures: Data collected from the student assessment methods and measures above, including the Student Levels of Proficiency Rubric, will be analyzed annually to assess the Marine Biology Program at UAS. Information derived from the data analysis will be used to evaluate the program, identify strengths and weaknesses in the program, and improve both curricular and pedagogical components of the program.

C. Responsibility: The Biology Assessment Program Coordinator will be responsible for coordinating student assessment activities and conducting the annual program assessment.

D. Timeline:

During the first cycle of assessment, the first goal and goal outcomes will be assessed:

Goal 1. The graduate will master fundamentals of biological science through:

1. Passing a two-semester sequence in Fundamentals of Biology
2. Understanding content areas pertaining to Biology
3. Understanding terminology specific to Biology
4. Understanding techniques employed in the field.

During the second assessment cycle, the second goal and goal outcomes will be assessed:

Goal 2. The graduate will understand fundamentals of mathematics, statistics, chemistry and physical sciences and how they relate to biological science through:

1. Passing fundamental courses in mathematics, statistics, chemistry and physical sciences
2. Understanding the content areas specific to the disciplines.

During the third assessment cycle, the third goal and goal outcomes will be assessed:

Goal 3. The graduate will master fundamentals of biology/marine biology

1. Passing the fundamentals of biology 2 semester course and the introduction to marine biology course.

During the fourth assessment cycle, the fourth goal and goal outcomes will be assessed:

Goal 4. The graduate will master an in-depth study of organismal-level biology, including ecology, physiology, genetics and evolution and related Biology electives

1. Passing organismal-level biology courses, including ecology, animal physiology, genetics and evolution

During the fifth assessment cycle, the fifth goal and goal outcomes will be assessed:

Goal 5. The graduate will master an in-depth study of a core in biology/marine biology that could include invertebrate zoology, marine mammalogy, phycology, physiology of marine organisms, ichthyology or marine ecology

1. Passing 3 core courses in biology/marine biology

VIII. Curriculum

Biology, B.S. Bachelor of Science Juneau

The Bachelor of Science degree in Biology provides students the opportunity to learn biological principles and skills in lecture, laboratory, and field courses. Student research is also emphasized throughout the program. Program faculty are actively involved in a wide range of disciplines, including marine ecology, behavioral ecology, marine mammalogy, crustacean physiology, and marine algology. The location of the University provides students with a "natural laboratory" that includes extensive marine habitat, rainforest, wetlands, and ice fields all within walking distance of the classrooms. A small student-to-professor ratio ensures a more personal approach to learning than is possible at larger universities. The Bachelor of Science program in biology comprises a core curriculum generally found nationwide in Bachelor of Science biology programs. Additional information about the biology program can be found at www.uas.alaska.edu/biology

Admission Requirements

Applicants enter as premajors and will be considered for full admission into the Bachelor of Science in Biology program after completion of the following:

1. MATH S107 (May be met by placement examination)
2. ENGL S111
3. BIOL S105 and BIOL S106
4. High School Chemistry or CHEM S103 with a C (2.0) or higher

When a student enters the major in Biology he or she is assigned a faculty advisor. The student and faculty advisor plan the student's curriculum, and the advisor's signature is required on registration documents.

Degree Requirements

Candidates must complete the General Education Requirements (GERs) as well as the specific program requirements listed below for a minimum of 120 credit hours. Courses in a degree program may be counted only once. Courses used to fulfill the major requirements cannot be used to fulfill the GERs. Specific recommendations for the GERs in Biology are listed below. Degree must include 48 credit hours of upper-division (300 or above) courses, 24 of which must be completed at UAS.

Minimum Credit Hours 120

General Education Requirements (PG. 58) 36
Must include:
MATH S200 Calculus I* 4
BIOL S105 Fundamentals of Biology I 4
BIOL S106 Fundamentals of Biology II 4
*Prerequisites include MATH S107 and MATH S108

Major Requirements 43

BIOL S271 Ecology 4
BIOL S310 Animal Physiology 4

BIOL S362 Genetics 4
BIOL S482 Evolution 4
CHEM S105 General Chemistry I 4
CHEM S106 General Chemistry II 4
CHEM S341 Organic and Biological Chemistry I 4
CHEM S342 Organic and Biological Chemistry II 4
STAT S273 Elementary Statistics 3

select both
PHYS S103 College Physics I 4
PHYS S104 College Physics II 4

or both
PHYS S211 General Physics I 4
PHYS S212 General Physics II 4

Biology Electives 20
Select four from the following (20 credits):
BIOL S215 Introduction to Marine Biology 3
BIOL S239 Introduction to Plant Biology 4
BIOL S300 Vertebrate Zoology 4
BIOL S305 Invertebrate Zoology 4
BIOL S373 Conservation Biology 4
BIOL S375 Current Topics in Biology* 4
BIOL S382 Wetlands Ecology 4
BIOL S384 Marine Mammalogy 4
BIOL S396 Field Studies in Behavior and Ecology** 1-6
BIOL S398/S498 Research** 1-6
BIOL S401 Phycology 4
BIOL S415 Physiology of Marine Animals 4
BIOL S426 Ornithology 4
BIOL S427 Introduction to Ichthyology 4
BIOL S441 Animal Behavior 4
BIOL S445 Vascular Plants of Southeast Alaska 3
BIOL S480 Aquatic Pollution 3
BIOL S481 Marine Ecology 4
BIOL S492 Biology Seminar* 2
BIOL S495 Behavioral Ecology 3
ENVS S415 Biogeography & Landscape 3

*Only 4 credits from BIOL S375 and 2 credits from BIOL S492 may be applied toward the Biology electives. Additional credits may be applied toward Electives.
**Up to 6 credits total from BIOL S396/398/498 may be applied.

Electives 21

Must include a minimum of 12 credits of upper division courses.

Marine Biology, B.S. Bachelor of Science Juneau

The B.S. degree in Marine Biology provides students with the opportunity to learn biological principles and skills in lecture, laboratory and field courses with a core curriculum in Marine Biology.

Admission Requirements: Pre-major status: Applicants enter as pre-majors and will be considered for full admission to the B.S. in Marine Biology after completion of the following:

1. MATH S107 (may be met by placement examination)
2. ENGL S111.
3. BIOL S105, BIOL S 106
4. High school chemistry or CHEM S103 with a "C" or higher.

When a student becomes a major in Marine Biology, he or she is assigned a faculty advisor. The student and faculty advisor plan the student's curriculum, and the advisor's signature is required on registration documents.

Degree Requirements: Candidates must complete the General Education Requirements (GERs) as well as the specific program requirements listed below for a minimum of 120 credit hours. Courses in a degree program may be counted only once. Courses used to fulfill the major requirements cannot be used to fulfill the GERs. Specific requirements for GERs in Marine Biology are listed below. The degree must include 48 credits of upper-division (300 or above) courses, 24 of which must be completed at UAS.

General Education Requirements	**36**
The following courses must be included in the GERs for a B.S. in Marine Biology: MATH 200, BIOL 105 and BIOL 106.	

Major Requirements	**46**
BIOL 215 Marine Biology	3
BIOL 271 Ecology	4
BIOL 310 Animal Physiology	4
BIOL 362 Genetics	4
BIOL 482 Evolution	4
CHEM 105 General Chemistry I	4
CHEM 106 General Chemistry II	4
CHEM 341 Organic and Biological Chemistry I	4
CHEM 342 Organic and Biological Chemistry II	4
PHYS 103 and 104 College Physics I and II or	8
PHYS 211 and 212 General Physics I and II	8
STAT 273 Elementary Statistics	3

Marine Biology Core	**11**
Select three from the following courses (11-12 credits total):	
BIOL S305 Invertebrate Zoology	4
BIOL S373 Conservation Biology	4
BIOL S384 Marine Mammalogy	4
BIOL S401 Phycology	4
BIOL S415 Physiology of Marine Organisms	4
BIOL S427 Introduction to Ichthyology	4
BIOL S481 Marine Ecology	
Biology Electives 8 credits from the following	**8**
Biology Electives 6	
Select from the following (6 credits total):	
BIOL 239 Intro to Plant Biology	4
BIOL 300 Vertebrate Zoology	4
BIOL 375 Special Topics in Biology **	1-3
BIOL 382 Wetlands Ecology	4
BIOL 396 Field Studies*	*
BIOL 398/498 Research*	*
BIOL 426 Ornithology	4
BIOL 441 Animal Behavior	4
BIOL 480 Aquatic Pollution	3
BIOL S492 Biology Seminar** 1	1
BIOL 495 Behavioral Ecology	3
* up to 6 credits total from BIOL 396/398/498 may be applied toward Biology electives	
** only 4 credits from BIOL S375 and 2 credits from BIOL S492 may be applied toward the Biology electives. Others may be applied toward general electives.	

Electives 18 credits to include a minimum of 12 credits from upper division courses.	**18**
GENERAL Electives21 Minimum of 12 credits from upper division courses.	

Minimum Credit Hours	**120**

Course Descriptions

The following are course descriptions for all courses listed in the above degree program. This includes descriptions for one new course and one minor change to an existing course description; all additions and changes required for Curriculum Committee review have been submitted on the required forms along with this proposal.

Biology Courses

BIOL S105 Fundamentals of Biology I
4 credits (3+3) J, K, GER
Introduction to basic principles of cell biology and evolution. Topics include cell structure, metabolism and genetics. Co–requisite: MATH S105.

BIOL S106 Fundamentals of Biology II
4 credits (3+3) J, K, GER
Continuation of basic principles of plants and animal anatomy and physiology. Topics include evolution, behavior, ecology, and groups of plants and animals. Prerequisite: BIOL S105; co–requisite: MATH S107.

BIOL S215 Introduction to Marine Biology
3 credits (3+0)
An introduction to the major characteristics of ocean ecosystems and the organisms that inhabit them. Includes physical, chemical, and biological principles that affect marine biodiversity. Prerequisite: BIOL S105 and S106.

BIOL S239 Introduction to Plant Biology
4 credits (3+3) J, K
Structure, function, ecology, and evolutionary patterns of the major groups of plants. Prerequisite: BIOL S105 and S106.

BIOL S271 Ecology
4 credits (3+3) J, K
Overview of the principles of ecology with emphasis on the organismal, population, community, ecosystem and biome levels. Aspects of the physical environment are included in the organismal ecology discussions. Laboratory sessions mainly are field exercises in biological sampling and analyses. Prerequisites: BIOL S105 & S106. Co–requisite: STAT 273.

BIOL S300 Vertebrate Zoology
4 credits (4+0) J
Evolution, classification, functional anatomy and general biology of vertebrates. Alaskan species will be highlighted. Prerequisite: BIOL S105 AND S106. No lab.

BIOL S305 Invertebrate Zoology
4 credits (3+3) J
Structure, function, classification, evolution and life histories of invertebrate animals. Marine invertebrate animals. Marine invertebrates are emphasized. Prerequisite: BIOL S105 and S106.

BIOL S310 Animal Physiology
4 credits (3+3) J
Chemical and physical principles underlying living processes, and the integration of these principles into the physiology of cells and whole organisms. Prerequisites: BIOL S105 and S106, MATH S107; Co-requisite: CHEM S341.

BIOL S362 Genetics
4 credits (3+2) J
Principles of inheritance; physiochemical properties of genetic systems. Prerequisites: BIOL S105 and S106, CHEM S106, MATH S107.

BIOL S373 Conservation Biology
4 credits (3+3) J
An exploration of how biological principles are applied to conserve diversity at all levels of biological organization, from genes to biomes. Prerequisite: BIOL S271.

BIOL S375 Current Topics in Biology
1–2 credits (Variable) J
This course provides students with first–hand accounts of current research in the biological sciences. Seminar speakers will present research results in a variety of subdisciplines, and students will discuss the significance with presenters and instructor. Number of credits may vary from term to term. May be repeated. Prerequisites: Permission and completion of 3 science credits.

BIOL S382 Wetlands Ecology
4 credits (3+3) J
All of the major aspects of wetlands from ice fields, alpine bogs, tarns, lakes, streams, deltas to the marine shores, emphasis is on: 1) identification of wetland categories based on aquatic plants, hydrology and soil types; 2) value, preservation, protection and restoration of wetlands; 3) federal and state regulations and 4) management, economics and mitigated use of wetlands. Laboratories will be based on local Alaskan and Northwest regional case studies and accepted regional case studies and accepted wetlands research techniques. Prerequisite: BIOL S271.

BIOL S384 Marine Mammalogy
4 credits (3+3) J
The evolution and classification of marine mammals will be presented as a framework for understanding their adaptations, physiology, anatomy, behavior, ecology, reproduction, and mating systems. Current research techniques and conservation issues will also be reviewed. Students will write and present a paper on a special topic. Two field trips (dates TBA). Prerequisite: BIOL S105 and S106, S271 and permission.

BIOL S396 Field Studies in Behavior and Ecology
1–6 credits (Variable) J
This course provides intensive field study in selected topics in behavior and ecology with emphasis on field methods. Each student will conduct an individual research project. Field topics may entail a deferred grade. Projects may be associated with on–going research projects or new

projects developed by the instructor and student. Letter grades or Pass/Fail may be arranged by permission of instructor. Number of credits will be determined by the scope of the project. May be repeated for up to 12 credits. Prerequisites: BIOL S105, S106, S271 and permission of instructor.

BIOL S401 Phycology
4 credits (2+4) J
Survey of freshwater and marine algae with emphasis on Alaskan species. Topics include: taxonomy, physiology, life histories, and ecology of the algae. Introduction to Plant Biology (BIOL S239) recommended before taking this course. Prerequisite: BIOL S105, S106.

BIOL S415 Physiology of Marine Organisms
4 credits (3+3) J
An integration of physiological concepts with ecology and evolution to examine how organisms adapt within a diversity of marine environments including the intertidal, subtidal and the deep sea. The course will emphasize biochemical adaptations within the processes of respiration, osmoregulation, thermoregulation, and metabolism of marine invertebrates, fishes, and marine mammals. Prerequisites: BIOL 310 and CHEM 341.

BIOL S426 Ornithology
4 credits (3+3) J
Evolution, classification, adaptations, distribution, behavior, breeding biology, population dynamics, and migration of birds. Several field trips. Prerequisite: BIOL S105 and S106.

BIOL S427 Introduction to Ichthyology
4 credits (3+2) J
Major groups of fishes, emphasizing the fishes of northwestern North America. Classification, structure, evolution, general biology and importance to man the major groups. Prerequisite: BIOL S105 and S106.

BIOL S441 Animal Behavior
4 credits (3+3) J
The mechanisms and adaptive nature of individual and social behaviors will be explored in lectures, readings, and laboratory and field exercises. Proximal and ultimate explanations for behavior are studied terms of genetics, ecology, and modern evolutionary theory. Laboratory and field exercises emphasize hypothesis testing through observation and analysis of behavior. BIOL S362 (Genetics) is highly recommended before taking this course. Prerequisite: BIOL S105, S106, S271 or consent of instructor.

BIOL S480 Aquatic Pollution
3 credits (3+0) J
Discusses all major kinds of aquatic pollution including oil, heavy metals, organic wastes, pulp mill effluent, PCBs, pesticides, ocean dumping, radioactive wastes, thermal pollution, and marine litter. Effects on biological systems are emphasized. Emphasis is on Marine Systems. Prerequisites: BIOL S105 and S106, CHEM S106.

BIOL S481 Marine Ecology
4 credits (3+3) J
In-depth study of the paradigms regarding the distribution and abundance of marine organisms including analysis and discussion of current primary literature. Major emphasis on how physical-biological interactions structure populations, communities, and ecosystems in the oceans. Students will complete a research project. Prerequisites: BIOL 271 and STAT 273.

BIOL S482 Evolution
4 credits (3+3) J
This course entails in–depth study of the mechanisms of evolution. The roles of genetic variation, natural selection, and adaptation, in speciation and other evolutionary processes will be examined in an historical content. Competing schools of thought from the era of The Origin of the Species to recent advances in molecular evolution will be considered. Prerequisites: BIOL S105, S106 and co-requisite: BIOL S362.

BIOL S495 Behavioral Ecology
3 credits (3+0) J
This course will teach research skills in the area of behavioral ecology and examine current issues in the study of behavior. Emphasis will be on developing testable hypotheses pertaining to the adaptive nature of behavior. Each student, in consultation with the instructor, will develop a specific project and reading list. Readings will be discussed in classroom sessions. Students will be required to prepare a research proposal including a full literature review. Animal Behavior (BIOL S441) is strongly recommended before taking this course. Prerequisites: BIOL S105, S106, S271 or permission.

BIOL S498 Research in Biology
(1-6 Variable credit) J
Individual research in the biological sciences undertaken by a student in consultation with a member of the Biology Program faculty. Students may submit research ideas to faculty and develop them into project with faculty input. Requires consent of advisor and appropriate faculty supervisor.

Chemistry Courses

CHEM S105 General Chemistry I
4 credits (3+4) J, K, S GER
Introduction to chemistry, including atomic and molecular structure; the principles of chemical change and related energy changes. Four hours lab per week required. Prerequisites: high school chemistry and MATH S107.

CHEM S106 General Chemistry II
4 credits (3+4) J, K, S GER
Introduction to chemistry, including atomic and molecular structure; the principles of chemical change and related energy changes. CHEM S106 includes the chemistry of the elements. Four hours lab per week required. Prerequisite: CHEM S105 with a “C” or better.

CHEM S341 Organic and Biological Chemistry I
4 credits (3+4) J
Theory and laboratory covering the fundamentals of organic chemistry including functional group reactivity, stereochemistry and spectroscopy. The laboratory provides practical experience with emphasis on organic synthesis, natural products and structure identification. Four hours lab per week required. Prerequisite: CHEM S106 with a "C" or better.

CHEM S342 Organic and Biological Chemistry II
4 credits (3+4) J
Lecture and laboratory which introduce the fundamental principles of biochemistry. Topics include structure and function of biological molecules, properties of enzymes, kinetics, bioenergetics, metabolism and molecular biology. Four hours lab per week required. Prerequisite: CHEM S341 with a "C" or better.

Physics Courses

PHYS S103 College Physics I
4 credits (3+3) J, K GER
Classical mechanics including mechanical energy, waves, sound and fluids. Prerequisite: high school physics and MATH S107 and MATH S108.

PHYS S104 College Physics II
4 credits (3+3) J, K GER
Electricity, magnetism, optics and an introduction to modern physics. Prerequisite: PHYS S103.

PHYS S211 General Physics I
4 credits (3+3) J GER
Calculus based study of principles of mechanics. Topics include energy, oscillations, sound and fluids. Prerequisites: high school physics and MATH 200.

PHYS S212 General Physics II
4 credits (3+3) J GER
Continuation of PHYS S211. Topics include electricity, magnetism, and optics. Prerequisite: PHYS S211.

Statistics Courses

STAT S273 Elementary Statistics
3 credits (3+0) J, K, S
Introduction to data analysis, least–squares regression, data production, sampling distributions, probability, confidence intervals, hypothesis testing, detection and analysis of patterns in data. Prerequisite: Math S107 or equivalent.

Appendix A. Sample Course Syllabus

BIOLOGY 415/PHYSIOLOGY OF MARINE ANIMALS

Instructor	Dr. Sherry Tamone Phone: 796-6599 Office: AD205 Office Hours: Tuesday, Wednesday 9-12 or by appointment Email: sltamone@uas.alaska.edu
Lectures **Laboratory**	Tuesday and Thursday, 1:15-2:45 pm AD 204 Monday 3:30-6:30 pm; AD314 and AD 109
Required Text	Environmental Physiology of Animals P. Wilmer, G. Stone, and I. Johnston, Blackwell Publishing Handouts and extra readings will be assigned for discussion
Prerequisites	Biology 310 (C or better), Chemistry 341, or the direct consent of the instructor.

Course Objectives: My objectives for teaching this course are to integrate many of the concepts that you have learned in previous more specialized courses (physiology, biochemistry, ecology) within the context of evolutionary physiology. More specifically, I aim to examine physiological adaptations of marine organisms because of our proximity to the marine environment and our uncanny interest in marine animals. Some of the environmental challenges facing marine animals have their basis in oxygen availability, temperature changes, and osmotic fluctuations. We will examine biological adaptations in enzymes, structural proteins, and other cellular constituents to understand how animals solve the problems associated with diverse marine environments. Additionally it is my goal to take an experimental approach to investigating physiology through individual research projects and discussions of pertinent primary literature that emphasizes certain methodology.

Exams: There will be two examinations worth 150 points apiece (see course outline). The first exam will cover lecture material up to and including February 18 and will be given on February 24th in the Learning Center. The second exam will emphasize material covered after February 28th, but may also include earlier material and will be administered in class on April 14th. Bring a calculator to each exam. Makeup exams are given ONLY with prior consent of the instructor!

Laboratory and Research Projects: The initial laboratories are designed to introduce students to common methodologies used to study physiological concepts and that may be incorporated into your individual research project during the semester. During the first three weeks of the course you will decide upon a research topic and conduct a literature search of your individual research project. We will use the laboratory periods in part to discuss primary literature relevant to your projects and to conduct the research for your projects. It is expected that all of your data collection will not take place during a 3-hour block but may require coming in at non-laboratory hours. Your research projects will allow you to prepare required solutions, use physiological equipment, collect and statistically analyze data and present your information to a general audience.

Research Proposal and Literature Review (100 points) Each student will develop a literature review and research proposal prior to embarking on collecting data. After you have chosen a research question (a scientific hypothesis), you will need to perform an in depth literature review to gain an appreciation of existing knowledge and develop protocols with which to test your hypothesis. You will generate a proposal that clearly presents the background and methods for your project. I expect this "proposal" to be 5-10 double spaced pages.

Research Presentation: Students will give a 20-minute presentation on their research project (whether it "worked" or not). Students are expected to utilize visual aids effectively and present the material without reading a script. Your presentation will be graded (50 points) with the following considerations

a) Introduction: a thorough review of the literature and a clear and concise statement of your hypothesis. Your background should clearly present your research objectives
b) Methods: Present your experimental design and methods of statistical analysis that you used to test your hypothesis
c) Results: Well labeled graphics and/or tables are mandatory. Statistical analysis is mandatory.
d) Conclusions: You should discuss how your results support your hypothesis and some future directions
e) Visual Appeal: A research presentation should use visual aids appropriately.

Research Abstract: Each student will submit an abstract (no more than 300 words) detailing their objectives and results of their research project. An abstract contains no citations and is written as a brief but detailed synopsis of the work. (50 points)

Grading: Your grade will reflect an accumulation of your total points earned in the class. Exams (300); Laboratory/recitation attendance, participation, and preparedness, and your commitment to your research project (100); Research project proposal including extensive literature review (100); Written abstract (50) Research Presentation (50).

A> 90%; B>80%; C> 70%; D> 60%; F<60%; Incompletes are only given in cases of medical emergencies

Competencies

In this course you will be expected to improve upon

1) Writing skills: each student will write a research proposal concerning their research project and a final abstract
2) Communication skills: each student will give a presentation covering their research project and take part in discussions.
3) Information literacy: student will read upper division level text and primary literature covering specific areas of biological research
4) Computer usage: students will analyze their data using contemporary software and generate written work using Microsoft Word or appropriate software.
5) Professionalism: students will work in a collaborative manner and be held responsible for completing coursework in the time provided. When giving their presentation, students will dress in a professional manner.
6) Critical thinking: students will take part in discussions during which integrating concepts plays an important role. We will analyze and critique some current literature in physiology literature

Course Outline

Week 1 Start January 10

Lab No Laboratory

Lectures

1/11 Introduction to the course and to developing a research projects. Introduction to physiological adaptation/

1/13 Fundamental mechanisms of adaptation (Chapter 2; EPA). The problems of size and scale (Chapter 3 EPA)

Week 2 Start January 17

Lab No lab because of Martin Luther King Holiday

Lectures

1/18 Library work on research projects. I have to be in Anchorage for the Marine Science Symposium.

1/20 Metabolism and Energy Supply (Chapter 6 EPA page 112-133)

Week 3 Start January 24

Lab Respirometry: *Part 1: Resting metabolic rates of invertebrates: does oxygen utilization scale with size? Using fiber optic probes to measure dissolved oxygen in marine invertebrates*

Lectures

1/25 Energy Budgets (Chapter 6 EPA page 133-140)

1/27 Temperature and its effects (Chapter 8; EPA)

Week 4 Start January 31

Lab Thermal tolerance: Effects of temperature stress on mussels (*Mytilus trossulus)*. May study other marine invertebrates as well.

Lectures

2/1 Thermal biology (chapter 8; EPA pg 175-192)

2/3 Thermal environments and thermal exchanges (192-221)

Assignment due on 2/3: Literature review for your project. This list should represent most of the literature that you will be using for your proposal, but may include more. The literature should be presented in a format consistent with Journal of Crustacean Biology. This is not a graded assignment but is intended to motivate you in getting your literature in hand. If this is not turned in, points will be detracted from your participation grade.

Week 5 Start February 7

Lab*:* Overview of the enzyme-linked immunosorbant assay (ELISA). Handout concerning this procedure will be available on UAS Online. Block microwell plates with bovine serum albumin. I have already coated the plates for you with IgG.

Lectures

2/8 Hormones in marine animals, the role of the crustacean eyestalk in molting, reproduction, and metabolism. (Chapter 10.6 and 10.7 EPA)

2/10 Smoltification: The role of hormones in the salmonid life cycle.

Week 6 Start February 14

Lab ELISA Part 2: *Preparing standards and unknown samples for the ELISA.* Meet in AD109

Lectures

2/15 ELISA Part 3: Developing the plates. Meet in AD109

2/17 Special topics; Hormones and chemical control systems (Chapter 10, EPA)

Assignment due on 2/22 (electronically) by 5:00 pm: Draft of your research proposal with detailed description of your methods. This will include an introduction (rationale) for your project, a well though out hypothesis, the proposed methods for testing your hypothesis, and an up-to-date reference list that best reflects your project and that you guide you in your research presentation to be given at the end of the semester.

Week 7 Start on February 21

Lab *Gel electrophoresis of crustacean tissues. Visualizing protein using specific stains. Quantifying proteins using the Bradford protein assay)*

2/22 No class as I am in Seattle

2/24 Midterm 1 in the Learning Center

Week 8 Start on Feb 28

Lab Begin Supervised Research Projects

Lectures

3/1 Coping with the environment; Marine Life (Chapter 11 EPA; 393-408) Osmoregulation

3/3 Coping with the environment; Marine Life (Chapter 11 EPA; 409-422) Respiration and Buoyancy

Week 9 Start on March 7 (Spring Break; no classes)

Week 10 March 14

Lab: *Supervised Research*

Lectures

3/15 Respiration and circulation (Chapter 7.5: 163-173) A review of oxygen binding and respiratory physiology with respect to marine animals

3/17 Finish with Diving Physiology, ADL, and buoyancy. Help Tyler capture sculpins

Week 11 Start March 21

Lab Supervised Research

Lectures

3/22 Coping with the environment: Shorelines and Estuaries

3/24 Paper Discussion on Emperor Penguins? Measuring ADL

Week 12 Start 3/28

Lab Supervised Research

Lectures

3/29 Special Aquatic Habitats (Chapter 14 EPA 535-540) Thermal Vents and Handling Sulfides

4/1 Bioluminescence and Color Change/Ocean Acidification

Week 13 Start 4/4

Lab Supervised Research

Lectures

4/5 Lab Work

4/7 Lab Work and Data Analysis

Week 14 Start 4/11

Lab Labs will need laptops for data analysis/Supervised Research should be finishing

Lectures

4/12 Lab Work and Data Analysis

4/14 Fish Stress (Lecture at UAF) 12:40 pm -1:40 pm Lena 101

4/15 Lab Work and Data Analysis

Assignment due on 4/17 by 5:00 pm: A detailed abstract of your project. No more than 300 words. I will grade these and then generate a presentation schedule.

Week 15 Start on April 18

Lab *Student Research Presentations (practice)*
4/19 *Student Presentations* (4)
4/21 *Student Presentations* (3 students)

Final Examination will be administered on April 26 at the assigned time (1:00 pm)

Appendix B. Biology Advisory Committee

The biology Advisory Committee will be composed of agency (State and Federal) professionals and other university faculty. We will seek to maintain an advisory committee made up of 6 professionals representing the following universities and agencies.

1) University of Alaska Fairbanks
2) Alaska Department of Fish and Game
3) NOAA
4) United States Forest Service
5) United States Fish and Wildlife
6) National Park Service

Appendix C. Exit Interview Questions

Exit Interview Questions for Graduating Seniors

What is your major degree? (circle one) Marine Biology or Biology (BA or BS)

1) What are your career goals? Do you feel that the UAS Marine Biology/Biology degree prepared you well for this career? Why or why not?

2) Have you participated in the following research activities as part of your degree at UAS?:
_____BIOL 498
_____Summer internship (with NOAA, ADF&G, Forest Service, etc.)
_____EPSCoR-funded undergraduate research fellowship
_____Volunteer work with a faculty member
_____Paid research assistantship during the Fall and/or Spring semester
_____Other: _____

Do you feel that you had sufficient research opportunities at UAS?

How did your research experience at UAS impact your educational experience?

3) Can you comment on the preparation that you received in:
a) communication (e.g. presentations to classes, discussion courses)

b) quantitative skills (e.g. statistics, generating and analyzing graphs)?
c) information literacy (e.g. literature-based research, finding sources of information)?
d) computer usage?
e) professional & ethical behavior?
f) critical thinking?

4) Were there one or two courses or academic experiences that embodied the essence of the Marine Biology/Biology degree for you? If so, which one(s)?

5) Overall, what was the best part of your experience in the Marine Biology/Biology program at UAS?

6) Overall, what was the worst part of your experience in the Marine Biology/Biology program at UAS?

7) Overall I am satisfied with my education in Marine Biology/Biology at UAS.

a. Strongly disagree
b. Disagree
c. Neutral
d. Agree
e. Strongly agree

8) We like to keep in touch with our graduates to track their career paths. If you're willing, please provide a permanent e-mail and a permanent phone number where we might reach you in the future. We'll keep the information confidential.

Thank you!