2012-2013

Florida Department of Education
Curriculum Framework

Program Title: **Marine Environmental Technology (MET)**
Career Cluster: **Agricultural, Food & Natural Resources**

	AS	AAS
CIP Number	1103060100	0103060100
Program Type	College Credit	College Credit
Standard Length	62 credit hours	62 credit hours
CTSO	N/A	N/A
SOC Codes (all applicable)	19-2041	19-2041
Targeted Occupation List	http://www.labormarketinfo.com/wec/TargetOccupationList.htm	
Perkins Technical Skill Attainment Inventory	http://www.fldoe.org/workforce/perkins/perkins_resources.asp	
Statewide Articulation	http://www.fldoe.org/workforce/dwdframe/artic_frame.asp	

This degree is designed to prepare students for a diverse set of employment opportunities in the field of marine environmental technology and other marine-oriented careers. During the program students will acquire the skills and knowledge necessary to enter the work force in a variety of marine oriented careers including technicians at environmental or research laboratories, environmental consulting industries, aquaculture/mariculture facilities, ecotourism, or marine conservation and restoration projects.

Purpose

The purpose of this program is to provide technician level training and supply skilled employees for the growing workforce demand in marine related environmental industries. Graduates of this program will obtain the fundamental academic skills necessary to be successful at the technician level and demonstrate an understanding of the fundamental concepts behind marine environmental science. Graduates will demonstrate the ability to: (1) collect marine related data above and below the water (i.e. on scuba), (2) write technical reports, (3) navigate and operate marine vessels, and (4) understand basic business and management concepts.

Program Structure

This program is a planned sequence of instruction consisting of 62 credit hours.

Laboratory Activities

Field laboratory or field trips activities are an integral part of this program. These activities provide hands on instruction in marine conservation, habitat assessments, data collection, and

ecosystem restoration. Field laboratory instruction demonstrates and teaches the proper use of common field sampling and research equipment. Field trips to regional marine laboratories or industry facilities provide operational examples of theoretical concepts taught in the classroom.

Most onsite laboratory activities associated with the MET program are centered on marine aquaculture activities. On-site laboratory facilities include: (1) an indoor marine ornamental laboratory with a sterile seawater supply, (2) a support and disease diagnostic laboratory adjacent to the marine ornamental lab, and (3) an outdoor system with six (6) 600 gallon polyethylene tanks with filtered sea-water pumped in from the ambient waters and/or drawn from a saltwater well.

Special Notes

Accommodations

Federal and state legislation requires the provision of accommodations for students with disabilities as identified on the secondary student's IEP or 504 plan or postsecondary student's accommodations' plan to meet individual needs and ensure equal access. Postsecondary students with disabilities must self-identify, present documentation, request accommodations if needed, and develop a plan with their postsecondary service provider. Accommodations received in postsecondary education may differ from those received in secondary education. Accommodations change the way the student is instructed. Students with disabilities may need accommodations in such areas as instructional methods and materials, assignments and assessments, time demands and schedules, learning environment, assistive technology and special communication systems. Documentation of the accommodations requested and provided should be maintained in a confidential file.

Articulation

To be transferable statewide between institutions, this program must have been reviewed, and a "transfer value" assigned the curriculum content by the appropriate Statewide Course Numbering System discipline committee. This does not preclude institutions from developing specific articulation agreements with each other.

For details on articulation agreements which correlate to programs and industry certifications refer to http://www.fldoe.org/workforce/dwdframe/artic_frame.asp.

Program Length

The AS degree requires the inclusion of a minimum of 15 credits of general education coursework according to SACS, and it must be transferable according to Rule 6A-14.030 (2), F.A.C. The AAS degree requires the inclusion of a minimum of 15 credits of general education coursework according to SACS. The standard length of this program is 62 credit hours according to Rule 6A-14.030, F.A.C.

Certificate Programs

A College Credit Certificate (CCC) consists of a program of instruction of less than sixty (60) credits of college-level courses, which is part of an AS or AAS degree program and prepares students for entry into employment (Rule 6A-14.030, F.A.C.). This MET AS/AAS degree program includes the following College Credit Certificates:

- Marine Mammal Care and Basic Training (Pending state approval)
- Tropical Ornamental Mariculture Technician (Pending state approval)

Standards

After successfully completing this program, the student will be able to perform the following:

A. MET Core Learning Outcomes:

01.0 Demonstrate proficiency in underwater scientific research and marine data collection methods.
02.0 Demonstrate an understanding of the basic knowledge and practices that form the foundation of the marine sciences.
03.0 Compose scientific and/or technical reports.
04.0 Demonstrate basic knowledge and skills necessary to operate and maintain marine vessels.
05.0 Demonstrate an understanding of marine ecosystems, environmental management, and resource conservation
06.0 Demonstrate an understanding of the fundamental principles of biology.
07.0 Comprehension of fundamental principles governing business and entrepreneurship.
08.0 Demonstrate an understanding of the fundamental principles of marine aquaculture.

B. Marine Assessment and Restoration Specialization Learning Outcomes:

09.0 Demonstrate a basic knowledge and understanding of specific marine habitat assessment protocols.
10.0 Demonstrate a basic knowledge and understanding of several marine habitat restoration protocols

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C. Marine Mammal Specialization Learning Outcomes:

11.0 Demonstrate an understanding of the fundamental principles of marine mammal anatomy and evolution.
12.0 Demonstrate basic knowledge of marine mammal social structure and culture.
13.0 Demonstrate proficiency of basic marine mammal training and husbandry techniques.
14.0 Demonstrate knowledge of principle marine mammal laws and regulations.
15.0 Describe and discuss research focused on marine mammals.
16.0 Demonstrate knowledge of conservation issues involving marine mammals
17.0 Demonstrate an understanding of the guiding principles and practices of marine mammals in human care.

D. Marine Aquaculture Specialization Learning Outcomes:

18.0 Demonstrate a thorough knowledge of aquaculture best management practices.
19.0 Indentify and diagnose common diseases and parasites that infect marine aquaculture organisms.
20.0 Demonstrate a moderate understanding of marine aquaculture systems.
21.0 Recognize appropriate nutritional requirements for the most common marine aquaculture organisms.

22.0 Demonstrate a basic understanding of marine aquaculture husbandry principles and practices.

2012-2013

Florida Department of Education
Student Performance Standards

Program Title: **Marine Environmental Technology (MET)**
CIP Numbers: **1103030100AS, 0103030100 AAS**
Program Length: **62 credit hours**
SOC Code(s): **19-2041**

A. MET Core Learning Outcomes:

01.0 Demonstrate proficiency in underwater scientific research and marine data collection methods. The student will be able to:

- 01.01 Demonstrate knowledge and competence at research diving techniques and procedures to support scientific research projects.
- 01.02 Demonstrate the use of transects and quadrants to quantify the distribution and abundance of sessile marine organisms within a defined research area.
- 01.03 Demonstrate methods for conducting quantitative surveys the distribution and abundance of fishes within a defined research area.
- 01.04 Demonstrate state-of-the-art underwater data collection, recording and preservation procedures necessary to support biological and archaeological research.
- 01.05 Demonstrate the basic knowledge necessary to conduct statistical analysis of the scientific data collected.
- 01.06 Synthesize what was learned about research diving and other data collection techniques through a presentation, project or case study.

02.0 Demonstrate an understanding of the basic knowledge and practices that form the foundation of the marine sciences. The student will be able to:

- 02.01 Define plate tectonic theory and distinguish between types of plate boundaries.
- 02.02 Illustrate the features of the sea floor that arise from tectonic activity.
- 02.03 Identify key oceanographic terms and apply them in discussion.
- 02.04 Describe the processes that created the earth and the ocean.
- 02.05 Explain how the physical and chemical properties of seawater are important in understanding the ocean.
- 02.06 Compare the physical, chemical and biological processes that affect the origin, transport and deposition of sediment.
- 02.07 Summarize the role of the ocean in weather and climate.
- 02.08 Explain the mechanisms that create both surface and sub-surface ocean currents.
- 02.09 Define four types of ocean waves and identify the forces that generate them.
- 02.10 Explain how the ocean determines the shape, features and composition of the coast line.
- 02.11 Describe the Scientific Method, and explain the nature and limitations of scientific investigation.
- 02.12 Recognize and explain the basic features that define and differentiate major marine phyla.
- 02.13 Describe the role of microbes in the ocean.

02.14 Describe the major anatomical features and physiologic systems of bony and cartilaginous fishes.
02.15 Explain the functional role of marine reptiles, seabirds and mammals in the marine environment.

03.0 Compose scientific and/or technical reports. The student will be able to:

03.01 List the typical components of a peer-reviewed scientific article.
03.02 Explain the peer-review process of publishing a scientific article.
03.03 Explain the function of each section of a scientific paper or technical report.
03.04 Critically analyze a scientific paper describing its thesis, methods, results and conclusions.
03.05 Create at least two reports formatted according to a scientific publishing format.

04.0 Demonstrate basic knowledge and skills necessary to operate and maintain marine vessels. The student will be able to:

04.01 Demonstrate coastwise navigation techniques using both dead reckoning and electronic methods.
04.02 Demonstrate competence at using basic knots and marlinspike skills.
04.03 Demonstrate mastery of the navigational “Rules of the Road” through the safe operation of a small vessel.
04.04 Demonstrate proper man-overboard recovery procedures.
04.05 Explain the concepts of stability, trim and hull form as they relate to vessel operation.
04.06 Demonstrate basic safe boat handling skills.
04.07 Demonstrate proper procedures for docking, anchoring, rafting and mooring a vessel.
04.08 Explain the appropriate response to vessel emergencies such as stranding, fire and damage containment.
04.09 Demonstrate proper marine radio operating procedures.

05.0 Demonstrate an understanding of marine ecosystems, environmental management, and resource conservation. The student will be able to:

05.01 Explain the essential components of ecology, and how energy flows through an ecosystem.
05.02 Explain the functional role of primary producers in the marine environment, and identify common species of marine plants and algae.
05.03 Explain the essential components of intertidal ecology, and how energy flows through various types of intertidal ecosystems.
05.04 Describe the features and functional systems in the intertidal, neritic, epipelagic and deep ocean regions.
05.05 Explain the basic functional ecology and energy flow on a coral reef.
05.06 List the various resources humans derived from the sea and what problems this presents.
05.07 Explain how humankind has and continues to impact the marine environment.
05.08 Describe methods and best practices currently in use to conserve marine ecosystems including but not limited to as marine spatial planning, integrated coastal zone management and marine protected areas.

05.09 Explain the concepts of “Tragedy of the Commons” and “Precautionary Principle” as they relate to marine ecosystem and resource conservation.

06.0 Demonstrate an understanding of the fundamental principles of biology. The student will be able to:

06.01 Describe the requirements/ingredients of life, its associated “machinery” and the special challenges of living in the sea.
06.02 Identify biological processes including photosynthesis/chemosynthesis, respiration, and homeostasis.
06.03 Explain the basic structure, growth, metabolism, reproduction, physiology, and genetics of cells and organisms.
06.04 Recognize evolutionary relationships and diversity among living organisms, and appreciate the importance of biodiversity.
06.05 Explain the characteristics and distinctive features of the domains and kingdoms of life.
06.06 Identify and classify organisms within major taxonomic groups.
06.07 Demonstrate basic biological laboratory techniques including the use of a microscope.
06.08 Interpret laboratory data and summarize the results.
06.09 Demonstrate the problem solving and critical thinking skills needed to assess and solve biologically-based questions.

07.0 Comprehension of fundamental principles governing business and entrepreneurship. The student will be able to:

07.01 Demonstrate a familiarity of entrepreneurship by understanding the characteristics and mindset of entrepreneurs.
07.02 Identify and evaluate opportunities within the marketplace, both for new venture creation and within existing organizations.
07.03 Create the tools necessary to act on an entrepreneurial opportunity by writing a business plan, building a management team, financing the opportunity and creating an innovative marketing plan.
07.04 Describe successful strategies and common mistakes made by successful entrepreneurs.
07.05 Describe the legal requirements and obstacles in starting a business venture.

08.0 Demonstrate an understanding of the fundamental principles of marine aquaculture. The student will be able to:

08.01 Demonstrate a basic understanding of marine aquaculture husbandry principles and practices.
08.02 Demonstrate the skills required to culture phytoplankton and zooplankton required for larval rearing.
08.03 Describe the basic types of marine aquaculture systems.
08.04 Describe the various types of common organisms and techniques currently used during marine aquaculture operations.
08.05 Demonstrate a basic knowledge of common diseases and parasites during marine aquaculture and methods for their control.

B. Marine Assessment and Restoration Specialization Learning Outcomes:

09.0 Demonstrate a basic knowledge and understanding of specific marine habitat assessment protocols – The student will be able to:

- 09.01 Describe specific marine habitat assessment methods.
- 09.02 Demonstrate a basic understanding of biodiversity concepts and assessment methods.
- 09.03 Identify and quantify marine organisms in specific marine habitats.
- 09.04 Perform successful marine habitat assessments.

10.0 Demonstrate a basic knowledge and understanding of several marine habitat restoration protocols – The student will be able to:

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- 10.01 Understand the criteria used to identify areas where habitat restoration is required.
- 10.02 Describe specific marine habitat restoration methods.
- 10.03 Obtain (e.g. culture) organisms for restoration.
- 10.04 Perform successful marine habitat restorations.

C. Marine Mammal Specialization Learning Outcomes:

11.0 Demonstrate an understanding of the fundamental principles of marine mammal anatomy and evolution. The student will be able to:

- 11.01 Demonstrate an understanding of the external and internal aspects of dolphin anatomy and physiology, and their role in the successful survival of a mammal in the marine environment.
- 11.02 Demonstrate knowledge of the anatomy and evolution of various marine mammals including other cetaceans, pinnipeds and sirenians.
- 11.03 Demonstrate knowledge of the evolution of marine mammals.

12.0 Demonstrate basic knowledge of marine mammal social structure and culture. The student will be able to:

- 12.01 Demonstrate an understanding of basic dolphin ecology as related to communication, foraging, reproduction, calf rearing and social structure.
- 12.02 Explain and outline marine mammal maternal characteristics, behaviorism human care and the wild, as well as prenatal care, birthing situations and maternity care of mother and neonate human care facilities.
- 12.03 Explain how the natural social ecology of dolphins and the importance and impact of it on how they are managed at human care facility.
- 12.04 Demonstrate an understanding of the basic social structure of other representative marine mammal taxa.
- 12.05 Demonstrate how the term “culture” has been theorized to apply to certain aspects of cetacean societies and how that impacts our understanding of their cognition.
- 12.06 Understand the portrayal of marine mammals in the media and how and why it has changed over time.
- 12.07 Understand the application of animal assistance to humans throughout history and the more recent use of marine mammals in military service and how the

latter has greatly contributed to our essential knowledge base of marine mammals overall.

13.0 Demonstrate proficiency of basic marine mammal training and husbandry techniques. The student will be able to:

13.01 Understand the philosophy and techniques of operant (behavioral) conditioning, with a focus on positive reinforcement in training behavior and its application to working with dolphins.
13.02 Demonstrate operant conditioning techniques through the use of learned hand signals in communicating requests for various trained behaviors from the dolphin.
13.03 Apply skills learned in animal care, handling and reinforcement during a live animal presentation for the general public.
13.04 Construct a plan for basic marine mammal care, dietary and medical needs, and animal handling.
13.05 Understand the medical issues unique to marine mammals, methods of treatment of bacterial, viral, fungal and parasitic disease, established preventive care practices.
13.06 Demonstrate the use of operant conditioning in training a new behavior through outlining, developing, implementing and modifying a behavior chain through practical application with the animals.
13.07 To sumarize the importance of voluntary medical behavior training, concepts and techniques used to desensitize animals to non-invasive medical equipment and rocedures. Understand the importance of the of trainer/animal relationship with regard to properly maintaining the health and well being of the animals.
13.08 To investigate and understand the purpose and necessity of animal enrichment including cognitive, development, and social aspects. Design and implement enrichment activities to enhance the habitat and activities of the animals.
13.09 To sumarize safety precautions and the social issues surrounding enrichment devices, habitat design, safety & maintenance social groupings, training and dolphin & sea lion nutrition & energetics.
13.10 To critique various career pathways and opportunities available in the field of marine mammal care and training, including necessary academics, field experience, trainer forums, further experiential education in the field, networking, etc.

14.0 Demonstrate knowledge of principle marine mammal laws and regulations. The student will be able to:

14.01 Understand and explain the laws and regulating agencies, and their evolution, designed to protect marine mammals in both the wild and human care as well as regulate facilities .
14.02 Understand the separate roles of both NOAA and the Department of Agriculture and how they impact marine mammals and marine mammal facilities.

15.0 Describe and discuss research focused on marine mammals. The student will be able to:

15.01 Describe the historical and current research efforts relating to dolphin cognition, behavior, acoustics, communication, strandings, physiology, reproduction and conservation.
15.02 Sumarize basic medical procedures and the importance and implications of husbandry techniques to marine mammal research.
15.03 Explain how research with dolphins in human care have expanded our understanding of their wild cousins and contributed to their conservation.
15.04 Sumarize trends in basic dolphin ethology, past and ongoing studies related to cognition, behavior and communication and its application in research, as well as an understanding of passive observational data collection and facilitation of active cognitive research.
15.05 Evaluate theories and research on dolphin echolocation and whistle production; implication of anthropogenic noise in the marine environment and ongoing research in the area.
15.06 Conduct independent behavioral observations.
15.07 Review research design and logistics as it applies to marine mammals in human care through a project design exercise conducted collaborativelythroughout the course, including an understanding of results analyses and interpretation.
15.08 Critique career pathways and requirements toward becoming a marine mammal research scientist in human care settings (ex situ) and in the field (in situ).

16.0 Demonstrate knowledge of conservation issues involving marine mammals. The student will be able to:

16.01 Understand the current conservation issues of international/domestic . concern which affect marine mammals and their environment, cumulative impacts both natural and human induced, as well asways in which individuals can affect the environment in a positive manner to conserve the species.
16.02 Master the skills in synthesizing new information and experiences with prior conceptions of dolphins and the marine environment to clearly refine their opinions and knowledge base.
16.03 Outline the organization of the Marine Mammal Stranding Network; procedures used in assisting and rehabilitating stranded marine mammals; international and domestic issues concerning threats to dolphins and the marine environment.
16.04 List anthropogenic impacts affecting marine mammals and their environment, and demonstrate an understanding of research needed in this area, implications of impacts and associated research.
16.05 Understand past and present state of whaling operations around the world and the processes and organizations that govern these activities.
16.06 Understand status of certain endangered marine mammal species and conservation measures to sustain their populations.

17.0 Demonstrate an understanding of the guiding principles and practices of marine mammals in human care. The student will be able to:

17.01 To diagram population management, including theories, tools and strategies for maintaining a population's genetic diversity and demographic stability in order to insure its long term persistence.
17.02 Summarize specific concerns surrounding appropriate design, construction and maintenance of aquatic mammal habitats for marine mammals in human care.

D. Marine Aquaculture Specialization Learning Outcomes:

18.0 Demonstrate a thorough knowledge of aquaculture best management practices. Students will be able to:

- 18.01 Describe the concept of aquaculture Best Management Practices.
- 18.02 Compile and analyze marine aquaculture industry management data.
- 18.03 Identify and demonstrate proper use of key Quality Management tools.
- 18.04 Develop and implement the key components and concepts of an aquaculture management plan.

19.0 Demonstrate a basic understanding of marine aquaculture husbandry principles and practices. Students will be able to:

- 19.01 Identify the principles of water quality specific to marine aquaculture from a variety of marine taxa.
- 19.02 Demonstrate a working knowledge of variety of husbandry techniques for most of the known marine species currently being cultured, including temperature and photoperiod control conducive to spawning and species specific life styles.
- 19.03 Understand basic selective breeding techniques for enhanced phenotypic traits.

20.0 Indentify and diagnose common diseases and parasites that infect marine aquaculture organisms. Students will be able to:

- 20.01 Demonstrate an understanding of the basic principles of disease in marine aquatic systems
- 20.02 Demonstrate an understanding of how the culture environment is associated with the occurrence and outbreak of disease and parasites in marine aquaculture systems.
- 20.03 Identify the differences between environmental, viral, bacterial, parasitic and fungal diseases of marine species.
- 20.04 Demonstrate a basic understanding of methodologies for treatment of diseases commonly encountered during marine aquaculture operations.
- 20.05 Demonstrate an understanding of the basic principles of marine aquatic health management and biosecurity.

21.0 Demonstrate a moderate understanding of marine aquaculture systems. Students will be able to:

- 21.01 Describe the various types of marine aquaculture systems and demonstrate the ability to distinguish the primary components of specific marine aquaculture systems.
- 21.02 Identify which systems are best for the culture and business model of the target species.
- 21.03 Recognize the System requirements for Integrated Multi-Trophic Mariculture (IMTM) systems.
- 21.04 Demonstrate an understanding of the impacts of specific marine aquaculture systems on the environment and especially marine ecosystems.
- 21.05 Demonstrate basic skills for computer automated drafting.

22.0 Recognize appropriate nutritional requirements for the most common marine aquaculture organisms. Students will be able to:

22.01 Recognize basic marine nutrient and biochemical energy fluxes (i.e. trophodynamics and bioenergetics) especially as they relate to species commonly associated with marine aquaculture.
22.02 Demonstrate a rudimentary understanding of biochemistry (e.g. proteins, lipids, carbohydrates, etc.) and nutrient metabolism in common marine aquaculture species.
22.03 Demonstrate an understanding of the metabolic role of vitamins and minerals and recognize symptoms of vitamin deficiency.
22.04 Recognize appropriate feeding management practices based on metabolic requirements of marine aquaculture target species.
22.05 Recognize the impacts of feeding strategies on the environment.