July 2007

Florida Department of Education
CURRICULUM FRAMEWORK

Program Title:	Aquaculture Management
Occupational Area:	Agriscience and Natural Resources
	PSV
CIP Number	0101.030301 AAS Degree
	1101.030301 AS Degree
Grade Level	College Credit
Standard Length	AAS Degree/AS Degree – 63 Credits

Program SOC Code – 11-9011.03 – Aquacultural Managers

I. MAJOR CONCEPTS/CONTENT: The purpose of this program is to prepare students for employment as hatchery technicians, hatchery managers, assistant farm managers, and farm managers, or aquacultural managers (11-9011.03).

The content includes, but is not limited to, instruction that prepares individuals to apply the economic and business principles involved in the organization, operation and management of aquaculture farms and businesses. Content includes, but is not limited to, instruction in ichthyology, fish breeding, fish nutrition, pond maintenance, diagnosis and treatment of diseases in fish, economic and marketing principles for the production of an aquatic crop, business management of a fish farm, and field experience necessary to operate an aquaculture operation.

II. LABORATORY ACTIVITIES: Aquaculture laboratory activities are an integral part of this curriculum. The activities include microscopic work, fish identification, disease diagnosis, fish necropsy, aquarium setup, water filtration, productivity measurements, water quality measurements, diet strategies, and field experience at aquaculture facilities.

III. SPECIAL NOTE: National Postsecondary Agricultural Student Organization is the appropriate career student organization for providing leadership and training and for reinforcing specific vocational skills. Career Student Organizations, when provided, shall be an integral part of the vocational instructional program, and the activities of such organizations are defined as part of the curriculum in accordance with Rule 6A-6.65 (8), FAC.

Planned and supervised occupational activities may be provided through directed laboratory experience, practicum or cooperative experience. Whenever the cooperative method of instruction is offered, the following is required for each student: a training plan signed by the student, teacher, and employer which includes instructional objectives and a list of on-the-job and in-school learning

experiences; and a work station which reflects equipment, skills and tasks which are relevant to the occupation which the student has chosen as a career goal. The student must receive compensation for work performed.

The typical length of this program is an associate degree. The standard credit hour length for this program is 63 hours.

IV. INTENDED OUTCOMES

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

01.0 Identify important aquaculture plants and animals and describe their culture in various production units.
02.0 Perform general aquaculture production unit operations.
03.0 Perform general aquaculture nursery systems operations.
04.0 Demonstrate an understanding of water quality and aquaculture.
05.0 Maintain good nutrition for aquaculture organisms.
06.0 Recognize and control common aquaculture maladies.
07.0 Operate and maintain aquaculture equipment.
08.0 Assist in the maturation, spawning, larval and juvenile rearing of aquaculture organisms.
09.0 Demonstrate an ability to manage aquatic species in multiple production units over time.
10.0 Apply business, economic and marketing principles to the production of an aquatic crop.
11.0 Demonstrate management skills required to operate an aquaculture farm.

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Florida Department of Education
STUDENT PERFORMANCE STANDARDS

Program Title: Aquaculture Management
Postsecondary Number: 0101.030301 AAS
1101.030301 AS

01.0 INDENTIFY IMPORTANT AQUACULTURE PLANTS AND ANIMALS AND DESCRIBE THEIR CULTURE IN VARIOUS PRODUCTION UNITS - The student will be able to:

- 01.01 Define aquaculture and describe the historical important of aquaculture to local, state, national and international economies.
- 01.02 List occupations in aquaculture production, processing, distribution, marketing, and service.
- 01.03 Identify important aquatic species and products produced by aquatic farmers in Florida, U. S., and foreign countries.
- 01.04 List the types of production units and systems employed by aquaculturists in Florida, U. S. and foreign countries.
- 01.05 Outline basic techniques for constructing ponds, tanks, raceways, net pens and cages.
- 01.06 Describe basic production techniques for the culture of plants, mollusks, crustaceans, and finfish.
- 01.07 List and describe the major factors in growth of aquaculture species.
- 01.08 List important criteria in selecting a site for an aquaculture farm.
- 01.09 Describe natural fisheries and aquaculture production trends.

02.0 PERFORM GENERAL AQUACULTURE PRODUCTION UNIT OPERATIONS - The student will be able to:

- 02.01 Identify and describe the general anatomy, biology and life cycles for aquaculture species studied in this program
- 02.02 Identify and describe the general morphology of aquatic macro and microalgae
- 02.03 List methods to help determine aquatic animal health and behavior for various aquaculture production units
- 02.04 Operate and perform system maintenance on aquaculture production units
- 02.05 List techniques for routine maintenance of aquaculture ponds, cage culture systems, and submerged lands
- 02.06 Identify common aquaculture predators and list predator control techniques
- 02.07 Describe feeds and feeding techniques for various aquaculture species and aquaculture production units
- 02.08 Record production data such as water quality parameters, feed amounts,

mortality and other routine information required for a specific operation on data sheets and enter into a computer

02.09 Demonstrate practical hands-on or field experience in operating a variety of aquaculture production units.

03.0 PERFORM GENERAL AQUACULTURE NURSERY SYSTEMS OPERATIONS - The student will be able to:

03.01 Describe reproduction, spawning behavior, larviculture, metamorphosis and juvenile stages of growth of important aquaculture species studied in this program

03.02 Maintain, clean and operate a broodstock tank and list important practices in managing broodstock

03.03 Start, maintain, count and harvest live feeds

03.04 Maintain a nursery system by demonstrating an ability to clean tanks and filtration equipment, adjust water flow and volume, set aeration, and monitor water quality and feeding levels

03.05 Describe and differentiate between land-based and field-based nursery systems, equipment and operations

03.06 Monitor and record routine data such as feed amounts and times, temperature, oxygen, salinity, and ammonia and enter data into a computer or log book

03.07 List and describe nursery production systems and larval husbandry techniques for fish, crustaceans, and mollusks

03.08 Demonstrate practical hands-on experience in handling a variety of juvenile aquaculture organisms and operating nursery production units.

04.0 DEMONSTRATE AN UNDERSTANDING OF WATER QUALITY AND AQUACULTURE - The student will be able to:

04.01 Define environmental variables and list ranges important for survival and growth of important aquaculture species

04.02 Demonstrate an understanding of aquifers, water quantity and management, and agricultural water use in Florida

04.03 Identify water quality measurements necessary for accurately culturing aquaculture organisms

04.04 Measure water quality parameters in aquaculture production units, record data in logs and computers, and interpret results

04.05 Describe the nitrogen cycle and identify system equipment and/or processes which reduce nitrogenous wastes

04.06 Discuss the importance of oxygen to the maintenance of production units and aquatic animal health and the effect of temperature on oxygen concentration

04.07 Describe processes in aquaculture production units that effect pH, alkalinity, carbon dioxide, oxygen, ammonia, and other environmental parameters

04.08 Measure primary productivity and discuss its importance in various aquaculture production units
04.09 Calculate water volumes for various sizes of aquaculture production units
04.10 List potential sources of aquaculture pollution and describe methods of preventing or abating these problems
04.11 Identify Best Management Practices for treating waste water from various aquaculture production units.

05.0 MAINTAIN GOOD NUTRITION FOR AQUACULTURE ORGANISMS - The student will be able to:

05.01 Outline the basic concepts of nutrition for plants, mollusks, crustaceans, and fish
05.02 Discuss the importance of nutrition to growth and survival of various aquaculture species
05.03 Identify feeding habits and practices of a variety of aquaculture species
05.04 List common ingredients and additives of aquatic feeds and identify practices in feeds formulation and manufacturing
05.05 Demonstrate an ability to culture live feeds including microalgae, rotifers and artemia and discuss their importance
05.06 Calculate feeding rates, growth and feed conversion ratios for various aquaculture species stocked at different densities and rates
05.07 List different feeding methods, measure feed and maintain feed records in logs and computers
05.08 Discuss and differentiate feeding practices for hatchery, nursery and grow out of mollusks
05.09 Discuss nutrition practices for culturing aquatic plants
05.10 Discuss the principles of bioenergetics to growth.

06.0 DIAGNOSE AND CONTROL COMMON AQUACULTURE MALADIES - The student will be able to:

06.01 Identify the common diseases that infect aquaculture organisms
06.02 Understand the basic mechanisms for control of disease
06.03 Identify common bacterial diseases and treatment options
06.04 Identify common mycotic diseases and treatment options
06.05 Identify common viral diseases and treatment options
06.06 I Identify common parasitic diseases and treatment options
06.07 Discuss the relationship of nutrition, water quality and stress how they may cause disease in aquaculture organisms
06.08 Prepare an aquatic organism for diagnostic examination or shipment
06.09 Observe various diseases of aquatic organisms and demonstrate use of a microscope
06.10 List approved drugs available for use in aquaculture
06.11 Describe approved chemicals and their use in treating diseases.

07.0 OPERATE AND MAINTAIN AQUACULTURE EQUIPMENT - The student will be able to:

- 07.01 List equipment used in various production units necessary to raise plants, mollusks, crustaceans, and fish
- 07.02 Set up and maintain standard aquaria
- 07.03 Set up a system to culture aquatic plants
- 07.04 Demonstrate an ability to correctly use aquaculture equipment including, but not limited to, a thermometer, oxygen meter, refractometer, pH meter, pump, graduated cylinder, beaker, nets, siphon, scales, sieves, calipers, secchi disk, and a microscope
- 07.05 List equipment options of a recirculating system including solids removal, biofiltration, sterilization and aeration, and explain their basic functions
- 07.06 Operate and perform system maintenance on a recirculating system
- 07.07 Estimate pumping requirements and select an appropriately sized pump for a given system and water volume
- 07.08 Layout a PVC plumbing scheme for a given aquaculture system with a sufficient number of valves to allow for bypass and isolation and then measure, cut and assemble that water system
- 07.09 Layout and put together an aeration system operated on airlift technology
- 07.10 Replace and install a pump
- 07.11 Perform simple calculations related to water volume, water flow and system loading
- 07.12 Use and operate tools and equipment safely.

08.0 ASSIST IN THE MATURATION, SPAWNING, LARVAL AND JUVENILE REARING OF AQUACULTURE ORGANISMS - The student will be able to:

- 08.01 Describe the reproductive anatomy, function of reproductive organs, and reproductive cycles of selected aquaculture organisms
- 08.02 Differentiate between males and females of the same species
- 08.03 Relate environmental factors to successful reproduction of various aquaculture species
- 08.04 Explain the use of hormones, anesthetics, chemicals, antibiotics, and other techniques to manage broodstock and accelerate reproductive cycles and contrast the difference between environmental conditioning and induced spawning techniques
- 08.05 Maintain and care for broodstock and prepare spawning tanks and/or systems
- 08.06 Describe maturation, spawning, hatching, and larval rearing techniques for selected aquaculture species
- 08.07 Discuss the importance of nutrition at various stages of the larval rearing cycle for selected aquaculture species
- 08.08 Use a microscope to examine the stages and condition of eggs and larvae

08.09 Prepare, stock, feed and maintain larval rearing tanks
08.10 Culture live feeds and calculate feeding rates
08.11 Outline a maturation system design for selected aquatic species
08.12 List important practices and tasks in hatchery management
08.13 Estimate production numbers from a given spawn of a given species
08.14 Record hatching date in logs and computers and interpret results

09.0 DEMONSTRATE AN ABILITY TO MANAGE AQUATIC SPECIES IN MULTIPLE PRODUCTION UNITS OVER TIME - The student will be able to:

09.01 Identify routine management techniques involved in aquaculture
09.02 Calculate system volume and stocking strategies for given aquaculture production units
09.03 Develop a written protocol and design data sheets for daily feeding, water quality measuring, system maintenance, and other factors for various aquaculture production units culturing a given species
09.04 Periodically sample or other wise determine growth and production unit biomass/density and adjust feeding rates accordingly
09.05 List methods of harvesting aquatic crops from various aquaculture production units and preparing them for shipment to market
09.06 Acclimate and transfer aquatic animals from one water source to another
09.07 Design, layout, build, and plumb a simple aquaculture recirculating or other aquaculture production unit system
09.08 Calculate production area or volume, stocking rates, densities, feeding rates, conversion and growth of a given species for a given aquaculture production unit system being supervised
09.09 Demonstrate an understanding of management principles and use of management decision-making tools, including a computer
09.10 List communication skills and identify work habits necessary for supervising employees.

10.0 APPLY BUSINESS, ECONOMIC AND MARKETING PRINCIPLES TO THE PRODUCTION OF AN AQUATIC CROP - The student will be able to:

10.01 Describe aquaculture production and value of selected species in Florida, domestically, and internationally
10.02 List and access sources of market information and statistics for selected aquaculture species
10.03 Identify sources of competition both locally and globally
10.04 Identify critical risk factors which may limit success of a farm
10.05 Itemize fixed and variable costs of an aquaculture venture
10.06 Write a hypothetical business plan and a production plan for an aquaculture venture
10.07 Describe factors and variables in selecting a site for an aquaculture facility, including land, water, proximity of markets, labor and community acceptance

10.08 Link culture system options to a given site and water resources
10.09 Predict hypothetical production numbers for a given facility with given variables
10.10 Outline a simple operating budget for an aquaculture facility including cash flow and financial statement
10.11 Describe characteristics of a well-planned aquaculture facility
10.12 Demonstrate use of a computer for record keeping, production and decision-making.

11.0 DEMONSTRATE MANAGEMENT SKILLS REQUIRED TO OPERATE AN AQUACULTURE FARM - The student will be able to:

11.01 List rules, state statutes and federal regulations important to aquaculture
11.02 Describe permitting procedures for various species, sites and aquaculture production units
11.03 List Best Management Practices necessary to operate and permit selected aquaculture facilities
11.04 Develop a production plan and budget for a given aquaculture facility, design a record keeping system, establish operating procedures, harvest schedules and determine potential profitability
11.05 Demonstrate an ability to maintain farm records including property, insurance, personnel, payroll, permits and licenses, equipment and tangible property, aquatic animal inventory, accounts receivable, accounts payable, and others
11.06 Define HACCP and discuss its importance to both processing and aquaculture
11.07 List management skills necessary for effective supervision of employees.