

AGRI-SCIENCE III

Aquaculture

Overview

Agri-Science III students will focus on those areas of interest they have developed over the previous two years and concentrate on developing skills more specific to those areas of interest. All Agri-Science curriculum is aligned with the national Agriculture, Food, and Natural Resources (AFNR) standards.

Agribusiness Systems (ABS) —the study of business principles, including management, marketing and finance, and their application to enterprises engaged in Agriculture, Food and Natural Resources

Agricultural Mechanics/Power, Structural and Technical Systems (PST)—the study of agricultural equipment, power systems, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding and project planning for agricultural structures

Animal Science/Animal Systems (AS)—the study of animal systems, including life processes, health, nutrition, genetics, management and processing, through the study of small animals, aquaculture, livestock, dairy, horses and/or poultry

Environmental Service Systems (ESS)—the study of systems, instruments and technology used in waste management and their influence on the environment

Food Products and Processing Systems (FPP)—the study of product development, quality assurance, food safety, production, sales and service, regulation and compliance, and food service within the food science industry

Natural Resource Systems (NRS)—the study of the management of soil, water, wildlife, forests and air as natural resources

Horticulture/Plant Systems (PS)—the study of plant life cycles, classifications, functions, structures, reproduction, media and nutrients, as well as growth and cultural practices, through the study of crops, turf grass, trees and shrubs and/or ornamental plants

Note that the AFNR standards pathways do not indicate aquaculture as an independent pathway. Aquaculture standards are drawn from various pathways, most notably Animal Systems.

Students are expected to follow a specific course of study related to their career interests and goals that will prepare them for further study after high school or direct entry into the workplace. Some students may elect to pursue study in two diverse areas. Course selection is developed with the assistance of the SAE advisors and classroom teachers.

Agri-Science III students will continue to have opportunities to further develop leadership skills through participation in the FFA. Students at this stage are encouraged to participate in FFA Career Development Events (CDEs) in order to further develop skills.

Aquaculture involves the growth, production, care and harvesting of aquatic crops such as fish and shellfish. Students will work in a closed systems aquaculture lab designing, constructing, repairing, and caring for re-circulating systems and aquaria. Topics covered are re-circulating systems design, equipment repair and maintenance, physiology of aquatic organisms, fish and shellfish production, aquaponics, mariculture, water quality, methods of commercial fisheries and aquaculture.

Units
Aquatic Systems Management
Mariculture
Production Aquaculture
Sustainable Aquaculture

Title: Agri-Science II Supervised Agricultural Experience (SAE)

Unit Overview: SAE is a vital aspect of agricultural education. As part of Agri-Science I & II students have explored their options and developed work experience programs suitable for young students exploring agriculture as a career. Students have learned how to keep records and the best methods for documenting their day to day work as well as their progress. By the end of Agri-Science II students have developed and implemented a clear plan for supervised work experience relating to their interests and career goals.

Agri-Science III students are expected to demonstrate increased responsibility and new learning relative to their SAEs. Through advanced SAE work, students may be more involved in starting and operating their own businesses or taking employment in agriculturally-related enterprises. It is strongly recommended that students apply for local and state FFA proficiency awards as well as the FFA State Degree.

SAE advisors work with individual students, parents, work-site mentors, and employers to ensure student activities are appropriate, meet student needs, and are in compliance with state labor laws. All students work with their SAE advisors to complete the Universal Structured Work-Based Learning Plan. In addition, some students must complete the Connecticut Department of Labor forms LED 75-1 (Workplace Learning Experiences for Minor Students in Hazardous Occupations) or the LED 31-23 (Workplace Learning Experiences for Minor Students Ages 14 or 15 in Non-Hazardous Occupations), or Unpaid Work Experience forms.

Suggested Time: On-going

Ledyard High School Expectations for Student Learning:

Read and write critically and effectively for a variety of purposes
Speak clearly and communicate ideas accurately in a variety of settings
Demonstrate critical thinking skills

Agriculture, Food, and Natural Resources Standards:

- CS.01.01.07.c** Evaluate actions taken and make appropriate modifications to personal goals.
- CS.01.03.02.c.** Create a plan of action to complete a task based on a conceptualized idea
- CS.01.06.03.c** Use problem solving strategies to solve a professional or personal issue
- CS.01.06.05.c** Implement a plan to develop new knowledge and skills related to professional and personal aspirations
- CS.02.03.03.c.** Demonstrate employability skills for a specific career
- CS.03.01.01.b.** Select the appropriate form of technical and business writing or communication for a specific situation.

CS.03.02.03.b. Practice ethical behaviors.

CS.07.04.01.c. Apply general workplace safety precautions/procedures.

CS.08.01.01.c. Use tools and equipment appropriately to complete a specific task.

ABS.03.01.01.a Maintain production and agri-business records

Common Core State Standards

RST.11-12.4 Determine the meaning of words and phrases as they are used in text, including analyzing how an author uses and refines the meaning of a key term over the course of a text

WHST.11-12.1.e Provide a concluding statement or section that follows from or supports the argument presented.

WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension

WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience

MP 6 Attend to precision

Objectives	Required Activities/ Suggested Activities	AFNR Standards/CCSS
Implement planned improvements to enhance or improve work experience program	<ul style="list-style-type: none"> • Develop and expand work experience activities/projects in line with career goals • Write SMART goals for SAE improvement over the year 	CS.01.01.07.c CS.01.03.02.c CS.01.06.03.c CS.01.06.05.c CS.02.03.03.c. ABS.03.01.01.a RST.11-12.4 WHST.11-12.4
Accurately (or independently) complete appropriate work experience forms utilizing AFNR standards	<ul style="list-style-type: none"> • Identify key skills necessary to complete the Structured Work-Based Learning Form using AFNR standards • Complete appropriate CT Departments of Labor and Education forms for student work experience independently 	CS.01.06.05.c CS.02.03.03.b. CS.03.01.01.b. WHST.9-10.4
Demonstrate effective and appropriate work skills	<ul style="list-style-type: none"> • Work safely and effectively • Document safe handling of equipment, plants, 	CS.01.06.03.c CS.02.03.03.c.

	<ul style="list-style-type: none"> and animals • Demonstrate appropriate workplace skills such as time management, interpersonal skills, organization, communication, technology and tool use, and problem solving 	CS.01.06.05.c CS.03.02.03.b. CS.07.04.01.c. CS.08.01.01.c. ABS.03.01.01.a RST.11-12.4 WHST.11-12.4
Develop and maintain clear records	<ul style="list-style-type: none"> • Document time spent in activities, skills learned, income, and expenses • Keep all SAE records in a well-organized binder • Provide evidence of work using photographs, videos, and journals • Meet with SAE advisor weekly during the school year and at least once during the summer • Set up/organize appointments with SAE advisor and employer/supervisor/parent 	CS.02.03.03.c. CS.03.01.01.b. ABS.03.01.01.a RST.11-12.4 WHST.11-12.1.e WHST.11-12.2a WHST.11-12.4

Vocabulary

- 501(c)(3)
- Entrepreneurship
- Hazardous Occupations
- Liability
- Non-Profit Entity
- Paid Placement
- Structured Work-Based Learning Plan
- Volunteer
- Worker's Compensation
- Work-site Mentor

Assessments:

- Weekly record checks
- Monthly and annual summaries
- On-site visits by advisor in coordination with parent/supervisor/employer
- SAE rubrics

Resources/Materials:

- AFNR Standards
- Binder and record sheets
- SDE/SDOL employment forms

Title: Aquatic Systems Management

Unit Overview: Students will focus on the various types of systems and equipment used in the aquaculture industry. The main focus will be the three methods of filtration: Mechanical, Biological and Chemical. We will explore these methods of filtration and how they are used to maintain optimum water quality and sustain a healthy environment for aquatic organisms. Frequent water tests, lab assessments and simulated scenarios will be given to fine tune their skills in water assessment, diagnosis and treatment. Students are also responsible for the proper functioning, maintenance, and cycling of our re-circulating systems.

Suggested Time: One quarter

Ledyard High School Expectations for Student Learning:

Read and Write critically and effectively for a variety of purposes
Employ problem solving skills effectively
Demonstrate critical thinking skills

Agriculture, Food, and Natural Resources Standards:

- AS.03.01.02.c.** Treat common diseases, parasites and physiological disorders of animals.
- AS.02.01.02.a.** Identify major animal species by common and scientific names.
- AS.02.03.02.c.** Develop efficient procedures to produce consistently high quality animals well suited for their intended purposes.
- AS.03.01.01.b.** Perform simple health check evaluations on animals
- AS.01.01.01.b.** Evaluate and describe characteristics of animals that developed in response to the animals' environment and led to their domestication.
- AS.04.01.01.c.** Select appropriate feedstuffs for animals based on factors such as economics, digestive system and nutritional needs.
- AS.07.01.01.a.** Identify facilities needed to house and produce each animal species safely and efficiently.
- AS.07.01.02.a.** Identify equipment and handling facilities used in modern animal production.
- AS.08.02.01.c.** Establish and maintain favorable environmental conditions for animal growth and performance.
- CS.01.01.01.c.** Work independently and in group settings to accomplish a task.
- CS.07.04.01.c.** Apply general workplace safety precautions/procedures.
- CS.08.01.01.c.** Use tools and equipment appropriately to complete a specific task.
- CS.08.01.02.b.** Demonstrate appropriate operation, storage, and maintenance techniques for tools and equipment.
- ESS.01.01.01.b.** Determine the appropriate sampling techniques needed to generate statistical analysis data, and prepare valid chemical laboratory samples according to instruction.
- ESS.04.02.01.b.** Evaluate environmental hazards created by different types of solid waste, solid waste accumulation and solid waste disposal.

- PST.03.03.02.a.** Apply hydrostatic and hydrodynamic principles in hydraulics and pneumatics, including Archimedes' principle and Pascal's law.
- PST.04.01.01.b.** Develop plans and sketches using drafting equipment and computer programs.

Common Core State Standards:

- WHST.11-12.2** Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- WHST 11-12.4** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose and audience
- RST 11-12.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
- MP1** Make sense of problems and persevere in solving them.
- MP2** Reason abstractly and quantitatively.
- MP4** Model with mathematics.
- MP5** Use appropriate tools strategically.
- MP6** Attend to precision.

Objectives	Required Activities/ Suggested Activities	AFNR Standards/CCSS
Compare and contrast the three methods of filtration in aquatic systems	<ul style="list-style-type: none"> • Define and differentiate among the three primary methods of filtration (biological, chemical, and mechanical) • Perform surface area calculations of biomedia to determine proper biofiltration according to water volume and crop sizes • Explain in writing the methods of chemical filtration in production systems • Introduce specific chemicals to a water sample to determine their effectiveness in controlling specific water parameters • Treat production tank water with specific 	CS.08.01.02.b ESS.01.01.01.b. AS.02.03.02.b AS.03.01.02.c AS.07.01.02.a MP1 MP2 MP3 MP5 MP6

	<p>chemicals to stabilize pH and minimize chlorine and ammonia</p> <ul style="list-style-type: none"> • Perform and graph results of nitrogen tests to determine effectiveness of biofiltration • Define and state examples of mechanical filtration • Assess production species health to determine specific types of chemical treatment 	
Assess written descriptions of aquatic systems and respond with a diagnosis and solutions.	<ul style="list-style-type: none"> • Read, assess, and respond to scenarios involving water quality issues, systems malfunction or fish health. • Perform water tests on an unknown sample to determine specific problems with water quality • Diagnose equipment malfunction based on a written description of system conditions • Provide solutions to water quality issues based on water test results and a written description of system conditions 	AS.02.03.02.c. AS.07.01.01.a RST.11-12.4 WHST.11-12.4
Assess the operational status of aquatic systems	<ul style="list-style-type: none"> • Perform a 'walk through' of the lab noting system conditions. • Identify system malfunctions and make suggestions to remedy issue. • Perform system maintenance based on operational assessment 	AS.01.01.01.b. AS.02.03.02.c. AS.03.01.01.b. AS.07.01.01.a CS.01.01.01.c. WHST.11-12.4
Evaluate mechanical functioning of filter devices	<ul style="list-style-type: none"> • Inspect aquatic system devices • Perform necessary maintenance on systems based on observations 	AS.02.03.02.c. AS.07.01.01.a CS.01.01.01.c.
Identify aquaculture equipment and components and describe their role in filtration and water quality.	<ul style="list-style-type: none"> • Identify and describe in writing the function of aquaculture equipment • Describe a typical layout of a re-circulating system detailing filtration devices and water movement. 	CS.08.01.02.b. AS.07.01.02.a. WHST.11-12.4

Demonstrate proper care and sanitation of aquaculture equipment	<ul style="list-style-type: none"> • Safely use aquaculture equipment • Demonstrate safe practices in the lab and classroom while working with equipment, tools and production systems • Discuss the importance of biosecurity 	AS.03.02.01.b AS.07.01.01.a AS.07.01.02.a. CS.07.04.01.c.
Identify aquaculture production/commercial fisheries species.	<ul style="list-style-type: none"> • Identify aquaculture species by common and binomial name • Use differences in morphological features of finfish to identify and differentiate among species • Compare production species water parameters and tolerance ranges 	AS.02.01.02.a.
Demonstrate appropriate maintenance techniques for re-circulating systems	<ul style="list-style-type: none"> • Demonstrate appropriate maintenance techniques for a functioning re-circulating system • Demonstrate proper use, care and sanitation of aquaculture equipment • Develop a maintenance log for lab equipment 	CS.01.01.01.c. CS.08.01.01.c AS.03.01.01.b AS.08.02.01.c. WHST.11-12.2a WHST.11-12.4
Safely and accurately test and analyze various water parameters to assess the impact on fish health	<ul style="list-style-type: none"> • Safely perform water tests according to instruction and classroom guidelines • Sample and test freshwater water parameters using water test kits • Determine and record water test results • Create an ongoing log of water sampling and results using spreadsheets. • Assess water quality by recording and analyzing results of the water tests • Locate, read and interpret MSDS's for water testing reagents • Use proper safety equipment/attire while water testing and working in the aquaculture lab 	AS..02.03.02.c. AS.03.01.01.b. CS.07.04.01.c CS.0.8.01.01.c. ESS.04.02.01.b RST.11-12.4 WHST.11-12.4 MP1 MP4 MP5

Design and size specific filtration equipment and plumbing for an aquatic system.	<ul style="list-style-type: none"> • Determine volumes of different containers • Size pumps according to volume and plumbing • Determine friction loss in PVC using head loss, fittings, size and run of plumbing. • Determine total electrical demand and cost of a system 	AS.07.01.01.a. AS.07.01.02.a. AS.08.02.01.c. PST.03.03.02.a. PST.04.01.01.b.. WHST.11-12.4 MP1 MP4 MP5
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Italicized items indicate technology use

Vocabulary:

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| <ul style="list-style-type: none"> • Activated Carbon • Air Diffuser • Air Lift • Bead Filter • Biofiltration • Biomedia • Bioreactor • Calcium Chloride • Carbon Dioxide • Carbonic Acid • Check Valve • Clarifier | <ul style="list-style-type: none"> • Directional valve • External Power Filter • Hardness • Hydrometer • In-Line Heater • Magnetic Drive Pump • Nitrification • Pressure Gauge • Production/Culture Tank • Protein Skimmer • Re-Circulating System • Refractometer | <ul style="list-style-type: none"> • Regenerative Blower • Settling Tank • Sodium Bicarbonate • Sodium Chloride • Sodium Thiosulphate • Submersible Pump • Sump • Un-ionized Ammonia • UV Filter • Wet/Dry Trickle Filter • Zeolite |
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Assessments:

- Unit Test
- Lab Quizzes
- Assignments: Chemical filtration, Biological filtration, Biofilter sizing, Mechanical Filtration, Acclimation/Transport, Weight Analysis, Pump Sizing, Friction Loss, and Volume calculations
- Class Participation Rubric

- Practical Work Rubric: Systems Maintenance
- Water Testing Assessment
- Aquaculture Equipment Identification Quiz
- Production Species Identification Quiz

Resources/Materials:

- Aquatic Systems Engineering: Devices and How they Function
- Fundamentals of Aquaculture: Step by Step Guide to Commercial Aquaculture
- Text: Aquaculture Science, Second Edition. Parker. Delmar, 2002
- Production Tanks
- Production Fish
- Re-Circulating Systems Equipment and Materials
- General Aquaculture Equipment
- PVC Plumbing – Fittings and pipe
- Water Testing Safety Equipment and Kits
- Computers: Microsoft Excel, Microsoft Word
- Southeastern Regional Aquaculture Center Publishing: www.srac.msstate.edu

Title: Mariculture

Unit Overview:

This unit will explore the interaction of aquatic organisms and their saltwater environment. Students will integrate aquaculture and marine biology by creating saltwater ecosystems to support life for the aquatic organisms collected and studied in class. In an effort to maintain a healthy environment for organisms, students will monitor and test the water quality of their systems. In an effort to interpret and follow the laws and regulations relative to Long Island Sound, students will keep accurate records of their organisms capture, release and casualties and report them to the Department of Energy and Environmental Protection.

Suggested Time: One quarter

Ledyard High School Expectations for Student Learning:

Read and write critically and effectively for a variety of purposes
Employ problem-solving skills effectively
Demonstrate critical thinking skills

Agriculture, Food, and Natural Resources Standards:

- AS.02.01.02.b.** Compare and contrast the hierarchical classification of the major agricultural animal species.
- AS.02.01.01.a.** Explain the importance of the binomial system of nomenclature.
- AS.03.01.01.b.** Perform simple health-check evaluations on animals.
- AS.05.01.01.b.** Describe the functions of major organs in the male and female reproductive systems.
- AS.06.01.01.b.** Outline safety procedures for working with animals by species.
- AS.06.02.01.b.** Discuss consumer concerns with animal production practices relative to human health.
- AS.08.01.01.b.** Outline methods of reducing the effects of animal agriculture on the environment.
- CS.01.01.01.c.** Work independently and in group settings to accomplish a task.
- CS.07.04.01.c.** Apply general workplace safety precautions/procedures.
- CS.08.01.01.c.** Use tools and equipment appropriately to complete a specific task.
- CS.08.01.02.b.** Demonstrate appropriate operation, storage, and maintenance techniques for tools and equipment.
- AS.08.02.01.c.** Establish and maintain favorable environmental conditions for animal growth and performance.
- ESS.01.01.01.c.** Analyze and interpret results of sample measurements.
- ESS.01.01.02.c.** Calibrate and use laboratory and field equipment and instruments according to standard operating procedures.
- ESS.03.03.01.b.** Describe characteristics of water that influence the biosphere and sustain life.
- ESS.03.03.04.c.** Test and document the quality of groundwater supplies.
- ESS.03.04.01.a.** Describe the functions of wetlands and differentiate types of wetlands.
- ESS.03.04.02.a.** Identify the major types of living organisms that inhabit wetlands.

- NRS.01.01.02.b.** Describe the interdependence of organisms within an ecosystem.
NRS.01.02.04.c. Conduct a field inventory of aquatic species, and record and document findings.
NRS.02.04.06.a. Identify characteristics of healthy marine and coastal natural resources.

Common Core State Standards:

- RST.11-12.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics
- WHST.11-12.2a.** Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multi-media when useful to aiding comprehension
- WHST.11-12.4** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience
- MP1** Make sense of problems and persevere in solving them
- MP 3** Construct viable arguments and critique the reasoning of others
- MP 4** Model with mathematics
- MP 5** Use appropriate tools strategically

Objectives	Required Activities/ Suggested Activities	AFNR Standards/CCSS
Identify Long Island Sound organisms and define their ecological role in their environment.	<ul style="list-style-type: none"> • Identify Long Island Sound organisms using a dichotomous key. • Identify and describe in writing life history of common Long Island Sound species. • Use differences in morphological features of finfish, mollusks and crustaceans to identify and differentiate among species • Classify organisms using zoological taxonomy system 	AS.01.01.01.a. AS.02.01.01.a. ESS.03.04.02.a. NRS.01.01.02.b. RST.11-12.4 WHST.11-12.4 NRS.01.02.04.c.
Design, create and maintain a saltwater ecosystem	<ul style="list-style-type: none"> • Use appropriate techniques and aquaculture practices to plan and create a saltwater tank • Demonstrate appropriate maintenance techniques for a saltwater system • Demonstrate proper use, care and sanitation of aquaculture equipment 	CS.08.01.01.c AS.08.02.01.c. WHST.11-12.4

	<ul style="list-style-type: none"> • Develop and use a task list for cleaning and maintaining a saltwater system 	
Safely and accurately test and analyze various water parameters	<ul style="list-style-type: none"> • Safely perform water tests according to instruction and classroom guidelines • Sample and test saltwater parameters using water test kits • Determine and record specific chemical levels based on water test results • Assess water quality by recording and analyzing results of the water tests • Discuss environmentally sound practices for disposal of waste water and water testing chemicals. • Locate, read and interpret MSDS's for water testing reagents • Use proper safety equipment/attire while water testing and working in the aquaculture lab 	<p>ESS.01.01.01.b. ESS.01.01.02.c. AS.03.01.01.b CS.07.04.01.c CS.0.8.01.01.c. CS.08.01.02.b. NRS.02.04.06.a. RST.11-12.4 WHST.11-12.2a WHST.11-12.4 MP1 MP4 MP5</p>
Identify and recognize healthy and unhealthy water quality parameters of Long Island Sound	<ul style="list-style-type: none"> • Analyze the water quality of a system and compare the results to Long Island sound water parameters. • Describe and diagram the Nitrogen Cycle and its role in filtration • Test, record and analyze all forms of nitrogen in a saltwater system • Analyze water test results to conclude, in writing, filtration, cycling and overall health of a saltwater system • Compare and contrast differences in saltwater and freshwater parameters through testing and analysis. • Read articles on hypoxia and discuss oxygen gain and consumption in Long Island Sound 	<p>ESS.03.03.01.b. ESS.04.02.01.b. ESS.03.03.04.c. NRS.02.04.06.a. WHST.11-12.2a WHST.11-12.4 MP1 MP3 MP4</p>
Compare and contrast the life cycles of Long Island Sound organisms	<ul style="list-style-type: none"> • Describe in writing the life cycles of the different varieties of plankton, mollusks, crustaceans and fish 	<p>AS.05.01.01.b. WHST.11-12.4</p>

	<ul style="list-style-type: none"> Organize native species into food webs and trophic levels 	
Test and control salinity in a mariculture system	<ul style="list-style-type: none"> Mix and balance correct amounts of salt to achieve a specific salinity in a saltwater system Use three different methods (refractometer, hydrometer and colorimeter) to test the salinity levels in water Express in writing the differences between saltwater, freshwater and estuarine environments Test and compare the salinity from three different natural bodies of water that link to Long Island Sound 	ESS.03.03.04.c. WHST.11-12.4 MP4 MP5
Identify species of economic importance from Long Island Sound.	<ul style="list-style-type: none"> Compare the different aquaculture and commercial fisheries species in Long Island sound Identify the methods of aquaculture used in the Long Island Sound. Identify the methods of commercial fisheries capture used in Long Island Sound 	AS.06.02.01.b. AS.02.01.02.b. RST.11-12.4
Explore the unique ecological aspects of Long Island Sound	<ul style="list-style-type: none"> Read given articles and answer questions on the unique ecological attributes of estuary environments Map and label the specific zones of Long Island Sound. Identify different habitats and explain the specific organisms that reside in each Identify wetlands and describe their ecological importance 	ESS.03.03.01.b ESS.03.04.01.a. RST.11-12.4 WHST.11-12.4
Identify the negative environmental impacts on Long Island Sound's water quality and ecology	<ul style="list-style-type: none"> Read given articles and explain in writing the sources and impacts of eutrophication Read given articles and discuss hypoxia in Long Island Sound 	ESS.03.03.01.b AS.08.01.01.b. RST.11-12.4 WHST.11-12.2a WHST.11-12.4

Use standard collection methods to acquire Long Island Sound organisms	<ul style="list-style-type: none"> • Use seine nets, cast nets and fish nets to acquire organisms from Long Island Sound • Acclimate organisms to simulated ecosystem 	NRS.01.02.04.c. AS.06.01.01.b.
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Italicized items indicate technology use

Vocabulary:

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| <ul style="list-style-type: none"> • Acclimation • Biological Filtration • Brackish • Cage Culture • Cast Net • Colorimetric Test Kit • Crustacea • Dichotomous Key • Dolomite • Dredge | <ul style="list-style-type: none"> • Estuary • Eutrophication • Fetch • Hydrometer • Hypoxia • Meroplankton • Mollusca • Phytoplankton • Primary Consumers • Primary Producers • Refractometer | <ul style="list-style-type: none"> • Salinity • Secondary Consumers • Seine Net • String Culture • Tertiary Consumers • Trawl Net • Tray Culture • Under Gravel Filter Plate • Zooplankton |
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Assessments:

- Organism Identification Quiz
- Water Quality Assessment Rubric
- Field Trip/Practical Work Rubric
- Class Participation Rubric
- Unit Test
- Assignments: Trophic Levels, Food Webs, Long Island Sound Zones, Hypoxia, Water Quality, Simulated Systems Setup, Mollusca, Crustacea, Plankton, Commercial Fisheries/Aquaculture, Water Testing, and Collection Permit.

Resources/Materials:

- Long Island Sound: An Atlas of Natural Resources
- Marine Animals of Southern New England and New York: Dichotomous Key
- LongIslandSoundStudy.net
- Aquaculture Text
- Aquaculture lab equipment
- Aquarium Equipment

- Collection Equipment
- Bluff Point
- www.ct.gov/deep/ Department of Energy and Environmental Protection

Title: Production Aquaculture

Unit Overview:

Production Aquaculture addresses the various tasks and responsibilities of operating a closed-system aquaculture facility. These tasks include monitoring production systems, logging fish growth and health, determining feed conversion and weight ratios, water quality analysis and the maintenance and sanitation of aquaculture equipment. Students will analyze water quality based on the physical state of an aquatic system, the physical state of the organisms and results of water quality testing. They will use this information to formulate and implement of plan of action to maintain and improve production in the aquaculture lab.

Suggested Time: One quarter

Ledyard High School Expectations for Student Learning:

Read and Write critically and effectively for a variety of purposes
Employ problem solving skills effectively
Demonstrate critical thinking skills

Agriculture, Food, and Natural Resources Standards:

- AS.01.01.01.b.** Evaluate and describe characteristics of animals that developed in response to the animals' environment and led to their domestication.
- AS.02.01.02.a.** Identify major animal species by common and scientific names.
- AS.02.03.01.b.** Compare and contrast desirable anatomical and physiological characteristics of animals within and between species.
- AS.02.03.02.b.** Assess an animal to determine if it has reached its optimal performance level based on anatomical and physiological characteristics.
- AS.03.01.01.b.** Perform simple health check evaluations on animals
- AS.03.01.02.c.** Treat common diseases, parasites and physiological disorders of animals.
- AS.03.02.01.b.** Discuss procedures at the local, state and national levels to ensure biosecurity of the animal industry.
- AS.04.01.01.c.** Select appropriate feedstuffs for animals based on factors such as economics, digestive system and nutritional needs.
- AS.04.01.02.b.** Appraise the adequacy of feed rations using data from the analysis of feedstuffs, animal requirements and performance.
- AS.06.01.01.c.** Interpret animal behaviors and execute protocols for safe handling of animals.
- AS.07.01.01.a.** Identify facilities needed to house and produce each animal species safely and efficiently.
- AS.07.01.02.a.** Identify equipment and handling facilities used in modern animal production.
- AS.08.02.01.c.** Establish and maintain favorable environmental conditions for animal growth and performance.
- CS.01.01.01.c.** Work independently and in group settings to accomplish a task.
- CS.07.04.01.c.** Apply general workplace safety precautions/procedures.
- CS.08.01.01.c.** Use tools and equipment appropriately to complete a specific task.
- CS.08.01.02.b.** Demonstrate appropriate operation, storage, and maintenance techniques for tools and equipment.

ESS.01.01.01.b. Determine the appropriate sampling techniques needed to generate statistical analysis data, and prepare valid chemical laboratory samples according to instruction.

ESS.04.02.01.b. Evaluate environmental hazards created by different types of solid waste, solid waste accumulation and solid waste disposal.

Common Core State Standards:

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics

WHST.11-12.2a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multi-media when useful to aiding comprehension

WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience

MP1 Make sense of problems and persevere in solving them

MP 4 Model with mathematics

MP 5 Use appropriate tools strategically

Objectives	Required Activities/ Suggested Activities	AFNR Standards/CCSS
Identify aquaculture equipment and components and describe their functions.	<ul style="list-style-type: none"> • Identify and define in writing the function of aquaculture equipment • Describe the function of aquatic systems components and their role in a production system. 	CS.08.01.02.b. AS.07.01.02.a. WHST.11-12.4
Identify aquaculture production/commercial fisheries species	<ul style="list-style-type: none"> • Identify and describe in writing the roles and uses of aquaculture production species • Identify aquaculture species by common and binomial name • Use differences in morphological features of finfish to identify and differentiate among species • Compare and contrast production species 	AS.02.01.02.a. AS.02.03.01.a. RST.11-12.4 WHST.11-12.4

	water parameters and tolerance ranges	
Demonstrate appropriate maintenance techniques for re-circulating systems	<ul style="list-style-type: none"> • Demonstrate appropriate maintenance techniques for a functioning re-circulating system • Demonstrate proper use, care and sanitation of aquaculture equipment • Develop and use a task list for cleaning and maintenance of re-circulating systems • Analyze and remedy system malfunctions 	CS.08.01.01.c AS.03.01.01.b AS.08.02.01.c. WHST.11-12.2a WHST.11-12.4
Safely and accurately test and analyze various water parameters	<ul style="list-style-type: none"> • Safely perform water tests according to instruction and classroom guidelines • Sample and test water parameters using water test kits • Determine and record specific chemical levels based on water test results • Assess water quality by recording and analyzing results of the water tests • Discuss environmentally sound practices for disposal of waste water and water testing chemicals. • Locate, read and interpret MSDS's for water testing reagents • Use proper safety equipment/attire while water testing and working in the aquaculture lab 	ESS.01.01.01.b. ESS.01.01.02.c. AS.03.01.01.b CS.07.04.01.c CS.0.8.01.01.c. CS.08.01.02.b. NRS.02.04.06.a. RST.11-12.4 WHST.11-12.4 MP1 MP4 MP5
Identify life stages of production fish based on size, weight, and age	<ul style="list-style-type: none"> • Weigh and measure fish to determine life stage • Record weights and crop sizes • Establish consistent crop sizes by combining populations of fish of similar size and weight 	AS.07.01.01.a. CS.01.01.01.c. WHST.11-12.4

Use safe fish handling techniques	<ul style="list-style-type: none"> • Demonstrate proper handling and transport of aquatic organisms. • Identify anatomical features of finfish that may cause human injury. • Properly acquire a sample of fish from a production system for weight analysis 	CS.01.01.01.c. AS.03.01.01.b. AS.06.01.01.c. MP4 MP5
Determine feed requirements, feed type and feed amounts for lab production fish	<ul style="list-style-type: none"> • Weigh, measure and record a sample production fish to determine average fish weight and crop size. • Determine feed percentages based on average fish weight and crop size. • Determine feed amounts per day based on crop size. • Create and implement feeding schedule 	AS.04.01.01.c AS.04.01.02.b. CS.01.01.01.c. CS.07.04.01.c. ESS.04.02.01.b. MP1 MP4 MP5
Determine feed conversion ratios based on fish measurements and feed	<ul style="list-style-type: none"> • Measure and record fish growth and feed using spreadsheets • Calculate feed conversion ratio based on feed and weight gain 	AS.04.01.01.c AS.04.01.02.b. MP1 MP4 MP5
Record and compare growth, feed and water quality data	<ul style="list-style-type: none"> • Use spreadsheets to record and assess on-going growth and feed data • Develop and use a task list for cleaning and maintenance of re-circulating systems • Create and complete growth and water quality logs for chosen production species • Provide an overall analysis of growth, production and health of a chosen production species 	CS.01.01.01.c. AS.03.01.01.b. AS.08.02.01.c ESS.01.01.01.b. WHST.11-12.4 MP4
Describe the characteristics of water chemistry during transport, and during acclimation.	<ul style="list-style-type: none"> • Test and assess water quality using water test kits. • Describe in writing the trends in water quality during transport • Use data to implement changes to water chemistry problems • Demonstrate proper acclimation of production species 	AS.03.01.02.c AS.03.01.01.b. CS.01.01.01.c. CS.07.04.01.c. RST.11-12.4 WHST.11-12.2a WHST.11-12.4 MP4

		MP5
Demonstrate proper care and sanitation of aquaculture equipment	<ul style="list-style-type: none"> • Safely use aquaculture equipment • Demonstrate safe practices in the lab and classroom while working with equipment, tools and production systems • Discuss the importance of biosecurity 	AS.03.02.01.b AS.07.01.01.a AS.07.01.02.a.

Vocabulary:

- | | | |
|---|--|---|
| <ul style="list-style-type: none"> • Bead Filter • Biofilter • Bioreactor • Biosecurity • Cage Culture • Cartridge Filter • Dredge | <ul style="list-style-type: none"> • Extensive Aquaculture • Flow-Through System • In-Line Heater • Intensive Aquaculture • Long Line • Monoculture • Net/Pen Culture | <ul style="list-style-type: none"> • Polyculture • Pond Culture • Purse Seine • Re-Circulating System • Trawler • UV Filtration |
|---|--|---|

Assessments:

- Unit Test
- Lab Quizzes
- Logbook Checklists
- Assignments: Weight Analysis, Feed Percentage, Feed Conversion Ratio, Biohazard, and Species Profile
- Fish Handling/Weigh in Practice Assessment
- Class Participation Rubric
- Practical Work Rubric: Systems Maintenance
- Water Testing Assessment
- Aquaculture Equipment Identification Quiz
- Production Species Identification Quiz

Resources/Materials:

- Aquatic Systems Engineering: Devices and How they Function
- Fundamentals of Aquaculture: Step by Step Guide to Commercial Aquaculture
- Text: Aquaculture Science, Second Edition. Parker. Delmar, 2002
- Production Tanks
- Production Lab Production fish
- Re-Circulating Systems Equipment and Materials
- General Aquaculture Equipment
- Water Testing Safety Equipment and Kits
- Computers: Microsoft Excel, Microsoft Word, Microsoft Powerpoint and Microsoft Publisher
- Southeastern Regional Aquaculture Center Publishing: www.srac.msstate.edu

Title: Sustainable Aquaculture

Unit Overview: This class explores modern practices of sustainable aquaculture. We will evaluate our current lab operations and create a plan to implement sustainable practices for future operation. Students will be responsible for several independent, ongoing projects. Our main goal will be to continue growth and production in the lab while attempting to recycle/reduce/reuse the resources we commonly use in our daily operations.

Suggested Time: One quarter

Ledyard High School Expectations for Student Learning:

Read and write critically and effectively for a variety of purposes

Employ problem-solving skills effectively

Demonstrate critical thinking skills

Agriculture, Food, and Natural Resources Standards:

- CS.06.02.01.a.** Use proper safety practices/personal protective equipment.
- CS.01.01.01.c.** Work independently and in group settings to accomplish a task.
- CS.07.04.01.c.** Apply general workplace safety precautions/procedures.
- CS.08.01.01.c.** Use tools and equipment appropriately to complete a specific task.
- CS.08.01.02.b.** Demonstrate appropriate operation, storage, and maintenance techniques for tools and equipment.
- AS.03.02.01.a.** Explain the importance of biosecurity to the animal industry
- AS.02.03.02.c.** Develop efficient procedures to produce consistently high quality animals, well suited for their intended purposes.
- AS.03.01.01.b.** Perform simple health-check evaluations on animals.
- ESS.01.01.01.b.** Determine the appropriate sampling techniques needed to generate statistical analysis data, and prepare valid chemical laboratory samples according to instruction.
- ESS.03.02.02.b.** Relate the activities of microorganisms in soil to environmental service systems.
- ESS.03.03.01.b.** Describe characteristics of water that influence the biosphere and sustain life.
- ESS.03.03.06.c.** Install and maintain pumps and associated delivery system.
- ESS.03.05.01.b.** Distinguish the characteristics of inorganic and organic compounds as they relate to environmental service systems.
- ESS.04.02.01.b.** Evaluate environmental hazards created by different types of solid waste, solid waste accumulation and solid waste disposal.
- ESS.04.02.02.c.** Collect and treat solid waste materials.
- PST.01.03.01.a.** Identify and demonstrate safe use and maintenance of measurement and layout tools.
- PST.04.03.01.a.** Identify criteria in selecting materials in agricultural construction/ fabrication.
- PST.04.01.01.a.** Identify symbols and drawing techniques used to develop plans and sketches.

- PS.02.03.01.a.** Identify the essential nutrients for plant growth and development and their major functions.
- PS.02.03.02.a.** Discuss the influence of pH and cation exchange capacity on the availability of nutrients.
- PS.03.01.02.a.** Demonstrate sowing techniques and provide favorable conditions for seed germination.
- PS.03.01.03.a.** Describe optimal conditions for asexual propagation and demonstrate techniques used to propagate plants by
- PS.03.02.01.b.** Inspect propagation material for evidence of pests or disease.
- PS.03.02.04.b.** Monitor the progress of plantings and determine the need to adjust environmental conditions cuttings, division, separation and layering.

Common Core State Standards

- RST.11-12.4** Determine the meaning of words and phrases as they are used in text, including analyzing how an author uses and refines the meaning of a key term over the course of a text
- WHST.11-12.1.e** Provide a concluding statement or section that follows from or supports the argument presented.
- WHST.11-12.2a** Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension
- WHST.11-12.4** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience

- MP1** Make sense of problems and persevere in solving them.
- MP2** Reason abstractly and quantitatively.
- MP4** Model with mathematics.
- MP5** Use appropriate tools strategically.
- MP6** Attend to precision.

Objectives	Required Activities/ Suggested Activities	AFNR Standards/CCSS
Discuss implementation of environmentally responsible aquaculture methods	<ul style="list-style-type: none"> • Research methods of sustainable agriculture • Read article and answer questions on environmentally responsible aquaculture • Discuss the resources and energy input/output of closed aquaculture production system • Brainstorm ideas for new methods that will reduce the resources and energy used in our aquaculture lab • Create a chart/picture of the resource 	ESS.03.03.01.b. CS.01.01.01.c AS.03.02.01.a ESS.04.02.01.b. PST.04.01.01.a. RST.11-12.4 WHST.11-12.2a

	input/output of a typical closed production system	
Research, evaluate and discuss current issues regarding production aquaculture and sustainable aquaculture	<ul style="list-style-type: none"> • Conduct on-line research of one current environmental issues regarding production aquaculture and another on sustainable aquaculture • Write a persuasive essay on selected issues • Cite sources appropriately • Take a clear stand on a current issue • Present findings to peers for discussion 	ESS.04.02.01.b. RST.11-12.4 WHST.11-12.1.e WHST.11-12.2a WHST.11-12.4
Identify aquaculture/aquaponics equipment and components and describe their role in filtration and water quality.	<ul style="list-style-type: none"> • Identify and describe in writing the function of specific aquaculture and aquaponics equipment • Describe a typical layout of a re-circulating system detailing filtration devices and water movement. • Describe a typical layout of an aquaponics system detailing the water movement, functions and filtration 	ESS.03.03.01.b. ESS.04.02.01.b. PST.04.03.01.a. PS.02.03.01.a. PS.02.03.02.a. WHST.11-12.4
Outline and discuss the essential nutrients of plant growth	<ul style="list-style-type: none"> • Discuss the three essential nutrients in plant growth and their availability in aquatic systems • Read, take notes and graph the Nitrogen cycle and its role in aquaculture filtration 	CS.01.01.01.c ESS.03.02.02.b. ESS.03.03.01.b. PS.02.03.01.a. RST.11-12.4 WHST.11-12.2a
Plan and discuss ideas for an aquarium aquaponics system	<ul style="list-style-type: none"> • Research online instruction manuals or videos for 'home made' aquarium aquaponics systems • Keep an ongoing log of ideas and methods used in the research • Gather in groups to discuss ideas 	CS.01.01.01.c PST.04.03.01.a. PST.04.01.01.a. RST.11-12.4 WHST.11-12.2a

<p>Plan, design, construct and assess a functioning aquaponics system.</p>	<ul style="list-style-type: none"> • Plan and design an aquaponics system for a specific area or use • Sketch a plan and materials list for an aquaponics system using notes from research and discussion • Build an aquaponics system based on design plan using filtration devices and equipment learned in class • Use proper tools and materials to follow plan • Journal and assess procedures and results of the planning, design, and construction of an aquaponics system. • Select appropriate aquatic organism and plants for system 	<p>CS.06.02.01.a. CS.01.01.01.c CS.07.04.01.c. CS.08.01.01.c CS.08.01.02.b AS.02.03.02.c ES S.01.01.01.b. ESS.03.03.06.c ESS.03.03.01.b. ESS.04.02.01.b. ESS.04.02.02.c. PST.01.03.01.a. PST.04.03.01.a. PST.04.01.01.a. PS.03.01.03.a. PS.03.02.04.b. WHST.11-12.1.e WHST.11-12.2a WHST.11-12.4</p>
<p>Work safely and efficiently in an aquaculture lab.</p>	<ul style="list-style-type: none"> • Maintain a clean and safe lab environment. • Demonstrate procedures for maintaining a safe lab such as cleaning equipment and surroundings as well as determining and eliminating potential workplace hazards. 	<p>CS.06.02.01.a CS.07.04.01.c. CS.08.01.02.b AS.03.02.01.a AS.02.03.02.c. AS.03.01 PS.03.02.01.b..01.b.</p>
<p>Evaluate the energy use of an aquatic system</p>	<ul style="list-style-type: none"> • Calculate the amount of energy used in the aquaculture lab production system • Calculate the amount of energy used in student designed aquaponics system • Determine the cost/month based on energy consumption • Create a Energy Guide tag for a production 	<p>PST.04.01.01.a. WHST.11-12.2a MP1 MP4 MP5</p>

	system and aquaponics system	
Compare and contrast the role of biological filtration in an aquaponics system	<ul style="list-style-type: none"> • Perform surface area calculations of biomedia to determine proper biofiltration according to water volume and crop sizes • Perform and graph results of nitrogen tests to determine effectiveness of biofiltration • Evaluate Biofiltration based on volume of tank and surface area of Biomedia • Determine the effectiveness of plants as biofilters using water test results 	CS.01.01.01.c CS.07.04.01.c. CS.08.01.01.c AS.03.02.01.a AS.03.01.01.b. ESS.01.01.01.b. ESS.03.02.02.b ESS.03.05.01.b. ESS.03.03.01.b. WHST.11-12.2a MP1 MP2 MP5 MP6
Assess the water quality of an aquaponics systems	<ul style="list-style-type: none"> • Safely perform necessary water tests to determine the proper nutrients and water quality in an aquaponics system. • Log test data to determine proper balance of nutrients and water parameters • Create an ongoing log of water sampling and results using spreadsheets. • Locate, read and interpret MSDS's for water testing reagents <ul style="list-style-type: none"> • Use proper safety equipment/attire while water testing and working in the aquaculture lab • Evaluate the health of the plants and animals used in the aquaponics system • Perform system adjustments based on assessments. 	CS.01.01.01.c CS.07.04.01.c. CS.08.01.02.b AS.03.01.01.b. ESS.01.01.01.b. ESS.03.03.01.b. ESS.03.03.06.c ESS.03.05.01.b. ESS.04.02.01.b. PS.03.02.01.b. PS.03.02.04.b. RST.11-12.4 WHST.11-12.4 MP1 MP2 MP4 MP5 MP6

<p>Size and design specific filtration devices and pump equipment for an aquaculture/aquaponics system.</p>	<ul style="list-style-type: none"> • Determine the appropriate size pumps for an aquatic system using friction loss, GPM and head. • Use a pump chart to determine correct sizing and GPM • Determine friction loss of PVC pipe and fittings • Design and evaluate a filtration device to capture particulate matter in an aquatic system 	<p>CS.07.04.01.c. CS.08.01.01.c CS.08.01.02.b ESS.03.03.06.c ESS.04.02.01.b. ESS.04.02.02.c. ESS.04.02.02.c. PST.01.03.01.a. PST.04.03.01.a. RST.11-12.4 WHST.11-12.4 MP1 MP4 MP5</p>
<p>Select and use specific plant species for aquaponics system</p>	<ul style="list-style-type: none"> • Determine the appropriate plants for use in aquaponics systems • Germinate or make cuttings of plants to use in aquaponics systems • Monitor plant growth and health 	<p>CS.07.04.01.c. CS.08.01.01.c PS.03.01.03.a. PS.03.02.01.b. PS.03.02.04.b. PS.03.01.02.a.</p>
<p>Describe the basic requirements necessary for good plant growth</p>	<ul style="list-style-type: none"> • Identify macro and micro nutrients • Describe how pH affects plant growth and how it can be regulated in water • Describe the role of nitrates and how it is consumed and produced in an aquatic system 	<p>ESS.03.02.02.b. PS.02.03.01.a. PS.02.03.02.a. PS.03.01.02.a. WHST.11-12.4</p>

Vocabulary:

- Activated carbon
- Air diffuser
- Air lift
- Aquaponics
- Bead filter
- Biofiltration
- Biomedia
- Bioreactor
- Carbonic acid
- Check valve
- Chemical filtration
- Dissolved oxygen
- External power filter
- GPM
- Hardness
- Head height
- Hydro corn
- In-line heater
- Macronutrients
- Magnetic drive pump
- Mechanical filtration
- Particulate matter
- Production/Culture tank
- Protein skimmer
- Regenerative blower
- Rockwool
- Settling tank
- Siphon
- Submersible pump
- Sump
- Sustainable aquaculture

Assessments:

- Quizzes
- Design and practical skills assessments
- Lab/Aquarium maintenance activities
- Assignments: Sustainable aquaculture, Aquaponics, Functions and mechanics of an aquaponics system, Brainstorming group session, Aquaponics on Youtube, Biofilter sizing, Pump sizing, Energy consumption, Nutrients in aquaponics, Plant deficiencies, Aquaculture production species.
- Class Participation Rubric
- Practical Work Rubrics
- Water Testing Assessments
- Project Journal (8 parts)
- Unit Test

Resources/Materials:

- Aquaponics Food Production: Raising Fish and Plants for Food and Profit. Nelson and Pade. 2008
- Aquatic Systems Engineering: Devices and How they Function. P.R. Escobal. DEP, 1996
- Text: Aquaculture Science, Second Edition. Parker. Delmar, 2002
- Production Tanks

- Production Fish
- Re-Circulating Systems Equipment and Materials
- General Aquaculture Equipment
- Greenhouse
- General Horticulture Equipment
- Greenhouse crop plants
- PVC Plumbing – Fittings and pipe
- Water Testing Safety Equipment and Kits
- Computers: Microsoft Excel, Microsoft Word, Internet
- Southeastern Regional Aquaculture Center Publishing: www.srac.msstate.edu