

Sophomore Aquaculture CURRICULUM



Grade Level(s): 10

Curriculum Author(s): Leanne Golembeski

Course Description:

This course is designed to introduce students to the basic concepts of aquaculture, aquatic ecosystems, water chemistry, and careers related to aquatic sciences. Evaluation is based on written assessments and performance based projects. Units include system components in recirculating aquaculture, finfish and shellfish anatomy, aquatic ecosystems, Connecticut fisheries, recreational fishing, water quality, and introduction to aquaponics. Job opportunities include aquaculture technician, hatchery manager, fish biologist, fish histologist, fish immunologist, wetlands conservationist, pond and stream manager, shellfish biologist, marine scientist, fish nutritionist, etc. During the year, students will plan for their Supervised Agricultural Experience (SAE) programs that are required for sophomore, junior, and senior Agriscience students, as well as participating in FFA activities and event planning.

Semester At A Glance

Unit Title	Overarching Essential Question	Overarching Enduring Understanding	<u>Vision of A Learner “I Can” Statements</u>
Introduction of aquaculture and Systems	What is the purpose of aquaculture?	Aquaculture is a large industry, both within the US and also globally. There are a variety of purposes for aquaculture	TCC1, TCC3, TCC4, CCE2, TI2, TI3, AA1, AA2
Freshwater Aquaculture	Why is freshwater aquaculture so important, and what are common practices used in the industry?	Aquaculture has various methods that are used in different areas of the state, country, and globally. There are some methods that are the most popular. Different equipment is used for specific set ups and practices.	TCC1, TCC2, TCC3, CCE1, CCE3, DE4, TI1, P2, AA1
Marine Water Aquaculture	Why is marine aquaculture so important, and how much does it impact CT?	Connecticut is known for their shellfish aquaculture and we have a NOAA lab right in Milford CT, that focuses on growing oysters. Marine aquaculture is a vital part to CT and their economical growth.	TCC1,CCE4,DE, P3, P4, AA1
Aquatic Ecology	Why is ecology important to the aquaculture industry?	Depending on the aquaculture system being used, the ecology of various aquatic ecosystems have a direct impact. Aquaculture can be done in various environments.	TCC1, TCC3, CCE1, CCE4, DE1, P3, AA3,



Unit 1 - Introduction of Aquaculture and Systems

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

Connecticut Aquaculture

- AQ.07.03.02.a.** Identify equipment and handling facilities used in modern aquaculture production
- AQ.07.03.01.b.** Critique designs for an aquaculture facility and prescribe alternative layouts and adjustments for the safe and efficient use of the facility
- AQ.07.03.02.b.** Explain how modern equipment and handling facilities enhance the safe and economic production of aquatic species.
- AQ.07.03.03.b.** Explain basic electrical, plumbing, and mechanical components of aquaponic system
- AQ.07.03.03.a.** Identify and describe the following parts of a recirculating aquaculture system (RAS) tank, sump or reservoir, pump, solid waste, filter, U/V sterilizer, heat exchanger, bio-filter, and aeration.

Common Core State Standards

- CSS.ELA -Writing W.6.1c** Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons.

Next Generation Science Standards

- HS-ETS1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Vision of A Learner Attributes: Students will be able to independently use their learning to...

TCC: THINK CRITICALLY AND CREATIVELY

- TCC1:** I can ask purposeful, insightful questions to find a variety of innovative solutions.
- TCC3:** I can integrate relevant information to produce multiple valid solutions.
- TCC4:** I can integrate my learning to adapt to experiences in the classroom, career and life.

CCE: COLLABORATE AND COMMUNICATE EFFECTIVELY

- CCE2:** I can give and receive actionable and relevant feedback with openness to be able to determine meaningful revisions for success.

TI: TAKE INITIATIVE

- TI2:** I can evaluate my objectives and a variety of credible resources to find the best solutions for any challenge.
- TI3:** I can formulate and investigate probing questions to further my learning.

AA: ADAPT AND ADJUST

- AA1:** I can evaluate different approaches and justify the best pathway to success.
- AA2:** I can assess my past successes and mistakes to change my approach.



<p>Understandings: Students will understand that...</p> <ul style="list-style-type: none"> • The purpose of aquaculture is to help control wildlife populations against overfishing and upkeep with seafood demand. • Aquaculture has positive economic impacts globally and locally, such as job creation, income generation, diversification of income sources, infrastructure development, market access, export opportunities, ancillary businesses, increased property values, sustainable practices, and technology transfer/knowledge exchange. • A recirculating aquaculture system is a method of fish farming that recycles and reuses water within a closed system, rather than continuously discharging water into the environment. 	<p>Essential Questions:</p> <ul style="list-style-type: none"> • What is the purpose of aquaculture? • How is aquaculture a sustainable practice within the agriculture industry? • How is a recirculating system a beneficial way to farm fish?
<p>Students will know...</p> <ul style="list-style-type: none"> • Students will know the benefits/downfalls that aquaculture bring to local communities • Students will know the importance of system maintenance, both in the classroom and in the aqua house. • Students will know proper pvp piping maintenance and system upkeep. • Students will know identifying factors on when tanks need maintenance • Students will know what maintenance/cleaning techniques work best for each specific tank. • Students will know the difference between an intensive aquaculture system vs. an extensive aquaculture system. 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • List positives and negatives that the industry brings to local communities. From economical benefits, jobs, and effects on day to day living. • Students will be able to verbally and physically demonstrate their understanding on how to put piping together for the outside systems in the aqua house. • Students will be able to verbally and physically demonstrate the procedure on proper siphoning techniques for the classroom tanks • Students will be able to identify when a system is clogged • Students will be able to identify when tank need cleaning • Students will be able to ID the different parts of the large aquaculture system outside in the aqua house
<p>Key Vocabulary: Aquaculture, Marine Water, Brackish Water, Freshwater, Algae, Fish, Shellfish, Biological Filter, Settling Tank, Tank,</p>	



Aquaculture System, Siphon, Deep Water Culture Bed, Pump, Submersible Pump, Hose, Valves, PVC piping

Assessment Evidence

Performance Tasks:

Formative and Interim: Cutting PVC piping properly: **TCC1, P4**
Formative and Interim: Gluing PVC piping properly: **TCC1, P4**
Formative: Siphoning a classroom tank: **TCC1, P4**
Formative: Performing water changes in both the classroom and the aqua house: **TCC1, P4**
Interim: ID'ing the different parts of the Aquaculture System outside in the aqua house: **TCC1, TI3**

Other Evidence:

Formative: Introduction to aquaculture Worksheet
Formative: PvC cutting and gluing worksheet
Formative: Getting to know the system (Aqua-House) worksheet
Formative: Aquaculture systems worksheet
Formative: Documentary and notes

Learning Plan

- Students will identify and explain the different parts to the large aquaculture system outside in the Aqua house: **TCC1, TI3**
- Students will understand the parts and maintenance to the aqua house system: **TI3, TCC3, AA2**
- Students will understand the procedures necessary for the maintenance of the classroom tanks: **TI3, TCC3, AA2**
- Students will understand the difference between intensive aquaculture methods vs. extensive aquaculture methods: **TI2,**

Teacher Resources:

[The Working Waterfront - American Aquaculture in the 21st Century](#) - Documentary on day-to-day life in aquaculture

Unit 2 - Freshwater Aquaculture

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

Connecticut Aquaculture

AQ.04.02.01.a. Explain the importance of biosecurity to the aquaculture industry

AQ.06.01.01.a. Explain the male and female reproductive organs of the major aquatic species

AQ.06.01.01.b. Describe the functions of the major organs in the male and female reproductive systems

AQ.06.02.01.a. Explain how age, size, life cycle, maturity level and health status affect the reproductive efficiency of male and female aquatic animals

AQ.07.03.03.a. Identify and describe the following parts of a recirculating aquaculture system (RAS) tank, sump or reservoir, pump, solid waste, filter, U/V sterilizer, heat exchanger, bio-filter, and aeration.

AQ.07.03.04.a. Describe how the bio-filter of a recirculating aquaculture system (RAS) converts ammonia to nitrite, and nitrite to nitrate. CT

Common Core State Standards

CSS.ELA - Writing. W.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.

Next Generation Science Standards

HS-LS4-3 Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Vision of A Learner Attributes: Students will be able to independently use their learning to...

TCC: THINK CRITICALLY AND CREATIVELY

TCC1: I can ask purposeful, insightful questions to find a variety of innovative solutions.

TCC3: I can integrate relevant information to produce multiple valid solutions.

TCC4: I can integrate my learning to adapt to experiences in the classroom, career and life.

CCE: COLLABORATE AND COMMUNICATE EFFECTIVELY

CCE1: I can initiate discussions with my peers and teachers about a variety of topics, respecting differing viewpoints, actively listening to others, and responding thoughtfully with peer-reviewed evidence that is free of bias.

CCE3: I can show initiative in prompting group discourse and fostering collaboration among others, providing actionable feedback, and working with others to solve problems and/or design products.

DE: DEMONSTRATE EMPATHY

DE4: I can work respectfully with all members of my community and support the needs of others.

TI: TAKE INITIATIVE

TI1: I can implement a realistic plan and adapt when necessary to achieve my goals.

P: PERSEVERE

P2: I can strengthen my weaknesses by identifying, initiating, and practicing appropriate strategies to become confident in my ability to overcome my challenges.

AA: ADAPT AND ADJUST

AA1: I can evaluate different approaches and justify the best pathway to success.

Understandings:

- Learning about aquatic ecosystems provides valuable insights and tools for developing sustainable and environmentally responsible aquaculture practices that support the long-term health of both farmed species and natural ecosystems
- In aquaculture, various types of filters are used to maintain water quality by removing waste products, uneaten feed, and other debris from the water. Mechanical, biological and chemical filters are commonly used, along with UV sterilizers and Ozone Generators; depending on your goal for your system.

Essential Questions:

- Why is learning about aquatic ecosystems important for aquaculture?
- What are the main types of filters being used in aquaculture and aquarium systems?

Students will know...

- Students will know all the types of filters that are used in the classroom and the aqua house
- Students will know what macroinvertebrates are
- Students will know the proper order of specific filters being used in a system
- Students will know how macroinvertebrates are direct indicators on the health of Nonnewaug River

Students will be able to...

- Students will be able to identify the types of freshwater ecosystems
- Students will be able to identify the areas that you can find macroinvertebrates
- Students will be able to identify the types of adaptations macroinvertebrates have
- Students will be able to collect macroinvertebrates



	<ul style="list-style-type: none"> Students will be able to identify various types of filters
<p>Key Vocabulary: Filters; Biological filters; Mechanical filters; Chemical filters; Ecosystems; Lotic Ecosystems; Lentic Ecosystems; Macroinvertebrates; D-Net; Adaptations</p>	
<p>Assessment Evidence</p>	
<p>Performance Tasks:</p> <ul style="list-style-type: none"> <i>Formative:</i> Collecting macroinvertebrates using various nets: TCC1, DE4, P2 <i>Formative:</i> Collecting macroinvertebrates without using nets: TCC1, DE4, P2 <i>Formative:</i> Identifying different types of macroinvertebrates: TCC4, CCE1 <i>Formative:</i> Setting up proper system filtration in the correct order: AA1 <i>Interim:</i> Filter Scavenger Hunt: TCC2 	<p>Other Evidence:</p> <ul style="list-style-type: none"> <i>Summative:</i> Macroinvertebrates River Study <i>Formative:</i> Types of filters - worksheet <i>Formative:</i> Filter Identification in lab space - worksheet <i>Summative:</i> Intro to Aqua and Freshwater
<p>Learning Plan</p>	
<ul style="list-style-type: none"> Students will learn about various freshwater ecosystems: TCC4 Students will learn how to conduct a river study with macroinvertebrates: TCC1, DE4, P2 Students will learn about the various filters that are used on campus in our systems: AA1, TCC2 	
<p>Teacher Resources:</p> <p>Dichotomous Key to Common Aquatic Invertebrates - Great example to use for our River Study and when students create their own Dichotomous Key in class.</p> <p>Macro Key Stream Study - This helps the students ID various organisms found and what key factors they should look for.</p>	



Unit 3 - Marine Water Aquaculture

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

Connecticut Aquaculture

AQ.07.03.02.b. Explain how modern equipment and handling facilities enhance the safe and economic production of aquatic species.

AQ.07.03.01.b. Critique designs for an aquaculture facility and prescribe alternative layouts and adjustments for the safe and efficient use of the facility

AQ.07.04.01.a. List the general standards (e.g. environmental, zoning, construction, that must be met in facilities for aquaculture production

Common Core State Standards

CSS.ELA - Literature W.9-10.9b Apply grades 9–10 Reading standards to literary nonfiction (e.g., “Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning”).

Next Generation Science Standards

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Vision of A Learner Attributes: Students will be able to independently use their learning to...

TCC: THINK CRITICALLY AND CREATIVELY

TCC1: I can ask purposeful, insightful questions to find a variety of innovative solutions.

CCE: COLLABORATE AND COMMUNICATE EFFECTIVELY

CCE4: I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

DE: DEMONSTRATE EMPATHY

DE1: I can acknowledge, process, and respond appropriately to others' comments and perspectives.

P: PERSEVERE

P3: I can accept constructive feedback and use setbacks to adjust my learning journey in order to reach my goals.

P4: I can take-on challenges and continuously engage in my own long-term strategies to overcome them to demonstrate through personal experience that failures are more instructive than discouraging.

AA: ADAPT AND ADJUST

AA4: I can create opportunities to extend my learning by remaining open-minded in any situation.

<p>Understandings:</p> <ul style="list-style-type: none"> • The shellfish industry plays a multifaceted role in Connecticut, contributing to the economy, environment, culture, and culinary landscape of the state. Its significance underscores the importance of sustainable management practices and ongoing efforts to support and promote the growth of the shellfish sector. • The work of the NOAA labs in Milford plays a crucial role in ensuring the sustainability and health of marine ecosystems and fisheries in the Northeast region of the United States. These labs conduct scientific research and provide essential data and expertise to aid in sustaining and improving the health of our fisheries and marine waters. 	<p>Essential Questions:</p> <ul style="list-style-type: none"> • How much of an impact does the shellfish industry have in CT? • What do the NOAA labs in Milford, CT do and why are they important?
<p>Students will know...</p> <ul style="list-style-type: none"> • Students will know what marine ecosystems there are • Students will know what NOAA stands for • Students will know the importance that NOAA has within CT • Students will know the different categories of shellfish • Students will know what benefits there are to culturing mollusks • Students will know what downfalls there are to culturing mollusks • Students will know the different methods of shellfish aquaculture • Students will know different parts of the shellfish internal and external anatomy • Students will understand the steps of growing a hatchery within CT 	<p>Students will be able to...</p> <ul style="list-style-type: none"> • Students will be able to identifying different marine ecosystems • Students will be able to list 2 different defining characteristics of each marine ecosystem • Students will be able to identify different parts of a clams anatomy • Students will be able to identify the different methods the shellfish industry used to cultivate their product • Students will be able to list the benefits that shellfish bring to the surrounding environment when being grown • Students will be able to personally contact local shellfish businesses to get the background of how their hatcheries began and what challenges they have come across, along with various solutions.



Key Vocabulary: NOAA; Shellfish; Mollusks; Bivalves; Univalves; Crustaceans; Active Mollusks; Shellfish anatomy (Internal and external parts); Ocean Ecosystem; Intertidal Zones; Business; Hatcheries; Networking

Assessment Evidence

Performance Tasks:

- *Interim:* Clam Dissection: **CCE4, DE1**
- *Summative:* Contacting local shellfish aquaculture business owners: **AA4, P3, P4**

Other Evidence:

- *Formative:* Shellfish basics - Worksheet
- *Formative:* Aquatic Ecosystems - Worksheet
- *Formative:* Shellfish Methods - Worksheet - **TCC1**
- *Formative:* NOAA/Milford Labs worksheet
- *Formative:* Clam dissection study review game - **CCE4**

Learning Plan

- Students will learn about various aquatic marine ecosystems - **TCC1**
- Students will be introduced to shellfish - **CCE4**
- Students will learn about the work that the Milford Labs do within the shellfish industry - **TI3**
- Students will learn about local shellfish hatcheries and how they began - **AA4, P3, P4, TCC1**

Teacher Resources:

[Sea Grant: Fifty Years of Science Serving America's Coast](#) - Video on importance of Sea Grant within CT and support of Aquaculture
[The Facts | Niantic Bay Shellfish Farm | United States](#) - Website on Niantic Bay Shellfish Farm (CT Shellfish Farm)
[Indian River Shellfish](#) - Website on Indian River Shellfish Farm (CT Shellfish Farm)
Hannah Pearson from Island Creek Oysters - Video tour of hatchery



Unit 4 - Aquatic Ecology

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

Connecticut Aquaculture

- AQ.08.01.01.a. Evaluate the effects of aquaculture on the environment
- AQ.08.01.01.b. Outline the methods of reducing the effects of aquaculture on the environment
- AQ.08.01.01.c. Apply sustainable principles and practices to aquaculture production and management
- AQ.08.02.02.a. Apply environmental and ecological concepts to aquaculture

Common Core State Standards

CSS.ELA - Literature. W.8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

Next Generation Science Standards

- HS-LS2-7** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-ESS3-1.** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Vision of A Learner Attributes: Students will be able to independently use their learning to...

TCC: THINK CRITICALLY AND CREATIVELY

- TCC1: I can ask purposeful, insightful questions to find a variety of innovative solutions.
- TCC3: I can integrate relevant information to produce multiple valid solutions.

CCE: COLLABORATE AND COMMUNICATE EFFECTIVELY

- CCE4: I can communicate and express my understanding in an authentic, respectful and relevant way, using the most effective mode of expression.

DE: DEMONSTRATE EMPATHY

- DE1: I can acknowledge, process, and respond appropriately to others' comments and perspectives.

TI: TAKE INITIATIVE

- TI2: I can evaluate my objectives and a variety of credible resources to find the best solutions for any challenge.

AA: ADAPT AND ADJUST

- AA3: I can adjust my expectations and behaviors to succeed in a changing and unpredictable environment.

P: PERSEVERE

P3: I can accept constructive feedback and use setbacks to adjust my learning journey in order to reach my goals.

Understandings: Students will understand that...

- Aquaculture, just as any other industry has its positives and negatives. It can help alleviate the pressure of overfishing and increase food security, but management practices need to be looked at to continue ensuring sustainable and environmental practices.
- Depending on the country and various factors, such as economics, government involvement and research; aquaculture's impact on the environment globally has various impacts in different geographic locations. The methods used can also vary, based on the resources provided.

Essential Questions:

- What are the ecological impacts that aquaculture has on the environment?
- Compared to the US, how is the environment affected by aquaculture on a global scale?

Students will know...

Students will know ecological impacts that aquaculture has on various environments

Students will know how large the aquaculture industry is in different parts of the world

Students will know what overfishing is

Students will be know what environmental factors are affected by aquaculture, in different countries (Different impacts because of different environments)

Students will know the difference between a food web and a food chain

Students will know how food webs/food chains are impacted by aquaculture systems

Students will be able to...

Students will be able to list at least 2 positive ecological impacts that aquaculture has on surrounding aquatic environments

Students will be able to list at least 2 negative ecological impacts that aquaculture has on surrounding aquatic environments

Students will be able to list 4 reasons overfishing has been a detrimental factor to our aquatic ecosystems

Students will be able to verbally explain the reason overfishing has contributed to the growth of the aquaculture industry

Key Vocabulary: Ecology; Food Web; Food Chain; Overfishing; Resources; Degradation; Bycatch; International waters; Territorial seas; Regulations; Laws



Assessment Evidence

Performance Tasks:

- *Formative:* Tragedy of the Commons: **TCC1, TCC3, CCE4**
- *Interim:* River Study: Food Webs: **DE1, TI2**

Other Evidence:

- *Formative:* Overfishing - Worksheet
- *Formative:* What is Ecology and why is it important? - Worksheet - **TCC1**
- *Formative:* Aquaculture Around the World - Worksheet - **AA3**
- *Summative:* Compare and Contrast Environmental Impact USA vs. Chosen Country - Research Project - **P3, DE1**
- *Summative:* Marine Water Aquaculture and Aquatic Ecology

Learning Plan

- Students will learn overall environmental impacts that aquaculture has, dependant on the method being used - **TCC3, CCE4,**
- Students will learn about the environments in other parts of the world, and how aquaculture impacts those environments - **P3, DE1**
- Students will learn about how aquaculture alters those food relationships in the waters and what those changes lead to - **DE1, TI2**

Teacher Resources:

[Overfishing | A Threat to the Oceans & Marine Life | Britannica](#) - Discussing the ecological impact of overfishing

 [What is aquaculture and can it prevent overfishing?](#) - Discussing how impactful aquaculture is to help with overfishing

