

Lesson 2: Aquaculture History and Overview

Objectives:

By the end of this lesson, students will be able to:

1. Describe the history of and impetus for aquaculture practices around the world.
2. Explain the role of aquaculture in meeting global seafood demand, and identify the broad categories of species cultured.
3. Discuss factors that affect growth of the aquaculture industry.

Overview:

Aquaculture, also known as underwater agriculture, is the cultivation of aquatic animals and plants. It has a long history dating back 4,000 years to China, with the husbandry of common carp. In the United States, aquaculture began in the late 19th century as a way to boost fish stocks for sport fishing. Aquaculture now accounts for 50% of world seafood supply and continues to grow, whereas wild-capture fisheries have stagnated or are in decline. This lesson plan provides a brief history of aquaculture. It also allows students to explore the role of aquaculture in meeting global seafood demand and factors that affect aquaculture production.

Science Standards:

EEn.2.7.1

- Explain how biotic and abiotic factors determine biome classification (temperature, rainfall, altitude, type of plant, latitude, type of animals).
- Compare impacts of biotic and abiotic factors on biodiversity.

EEn.2.7.3

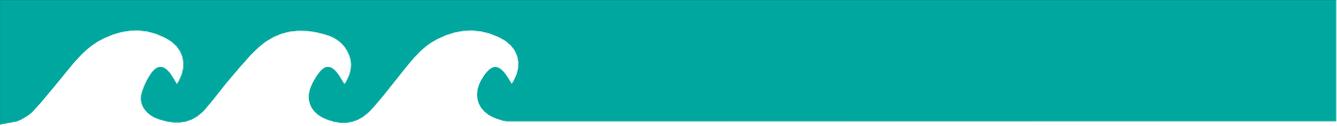
- Explain effects of human population growth, habitat alteration, introduction of invasive species, pollution and overharvesting on various plant and animal species in North Carolina.

EEn.2.8.2

- Critique the advantages and disadvantages of traditional agriculture/aquaculture techniques and compare with sustainable agriculture/aquaculture techniques. Include the economics and environmental impacts in this comparison.
- Judge potential impact of sustainable techniques on environmental quality (include magnitude, duration, frequency).

Grade Level: 9-12

Duration: 2 class periods



Vocabulary:

aquaculture: breeding, rearing and harvesting of animals and plants in all types of aquatic environments

cultivation: raising or improvement of animals, fish, etc., especially for commercial purposes

fish hatchery: a place for artificial propagation of fish to help support wild stocks and provide fish for harvest

husbandry: breeding of animals in captivity to prevent extinction of wild populations and to amplify population numbers

mariculture: cultivation of the living resources of the marine environment, including marine finfish, shellfish and plants

sport fishing: catching of fish such as salmon, trout and tuna for fun or competition, often regulated by licensing and management agencies

wild-capture fisheries: wild fish caught for commercial harvest and sale

Background:

History – Oral histories date aquaculture to 4000 B.C., although the first known written record of aquaculture practices is from the fifth century B.C. The birthplace of aquaculture is generally considered to be China, where fish farmers initially raised common carp (*Cyprinus carpio*). Chinese silkworm farmers grew carp in ponds, where silkworm pupae and feces provided supplemental food for the fish.

The carp ponds were just one form of aquaculture that the Chinese experimented with. Chinese fishers also noticed that migrating fish sometimes got trapped in semi-enclosed waterways. By regularly restocking these waterways, fishers could increase their catch.

During the Tang Dynasty (A.D. 618-906), a matter of politics motivated fish farmers to cultivate new fish species. The Tang emperor's family name was "Li," which also happened to be the name of the widely cultivated common carp. Traditionally, anything that shared the emperor's name was sacred and should not be eaten.

An imperial decree was issued prohibiting the culture of common carp, as well as other activities connected with the fish. Instead of constraining the development of aquaculture, however, the decree inspired innovation. Chinese fish farmers had success culturing other species of carp, including silver carp, big-head carp, grass carp and mud carp.

In the U.S., aquaculture dates back to the late 19th century, when state and federal agencies were exploring ways to enhance sport fishing opportunities. The U.S. Commission of Fish and Fisheries was established in 1871, and one of its goals was to propagate fish — including trout and channel catfish — for stocking in freshwater streams, lakes, reservoirs and farm ponds.

Some of the first fish hatcheries in the U.S. opened soon after. Early research at these hatcheries refined technology used to spawn and rear channel catfish and species in the salmon family. Those efforts provided the technical foundation for aquaculture to develop in the mid- to late 1900s. The commercial industry in the U.S. became well established in the second half of the 20th century.



Seafood Demand and Supply – Wild-capture fisheries alone cannot meet the global demand for seafood. While aquaculture production continues to grow, wild-capture fisheries have leveled off or are in decline. Aquaculture now accounts for 50% of world seafood supply.

Nearly 90% of the world's aquaculture products come from Asia. China represents the lion's share of global production, at 60%. Other top global producers are Japan, India, Norway and Vietnam. Though the U.S. is a major consumer of aquaculture products, its share of global production is comparatively small. In fact, the U.S. imports most of its seafood.

Aquaculture has the potential to reduce U.S. dependence on seafood imports, but its growth depends on technological improvements and healthy water resources, as well as on a business climate and public policy that are favorable. Growth of marine aquaculture especially depends on public support.

Some opposition to aquaculture stems from concerns about its environmental impacts. For example, cultivated finfish species can generate significant waste products — namely, poop — that must be managed. In the U.S., marine aquaculture occurs in coastal or marine waters that are managed for the public's use. Marine aquaculture producers may face competition from commercial fishers, recreational boaters and coastal property owners who all use or enjoy these public waters.

Aquaculture Species Raised – Species raised through aquaculture can be used to help boost wild populations or for human consumption. Other cultivated species include ornamental fish for the aquarium trade and plant species used in pharmaceutical, nutritional and biotechnology products.

Aquaculture can be divided into species that live in fresh water and those that live in salt water. The mainstay of the U.S. aquaculture industry is the production of freshwater channel catfish (*Ictalurus punctatus*), which occurs largely in ponds in the southeastern states of Mississippi, Louisiana, Arkansas and Alabama. Catfish represent 44% of the total volume of all aquaculture species raised in the U.S. However, catfish culture has declined to some extent in recent years because of high feed costs and intense competition from imported, frozen fillet products from Asia. Other significant cultivated freshwater species grown in the U.S. are rainbow trout and tilapia.

The cultivation of species in salt water is known as marine aquaculture, or mariculture. Such species include finfish, shellfish such as mollusks and crustaceans, as well as plant species like kelp. Shellfish — that is, bivalve mollusks like oysters and clams — are the top mariculture species grown in the U.S. They are cultured in near-shore ocean areas of every coastal state and represent about one-third of the total volume of all U.S. aquaculture production. Crawfish, clams, Atlantic salmon and white shrimp are other significant marine species cultured here. Atlantic salmon is the only marine finfish species raised in the open ocean in the U.S. They are grown in net pens in areas along the coast.

Activity:

The teacher will share the aquaculture overview PowerPoint presentation. Presenter notes are provided at the bottom of the presentation slides. Students should use the worksheet found at the end of this lesson to answer the following questions as they listen to the presentation.

Question and Answer Key:

1. In which country did aquaculture originate?

China

2. What was the first aquaculture species cultured? **Common carp**

3. How was aquaculture first used in the U.S.?

To restock fish for sport fishing

4. What percentage of world seafood supply does aquaculture represent? **50%**

5. What percentage of global aquaculture production does the U.S. represent?

Less than 1%

6. What is the number-one aquaculture species (by value) farmed in the U.S.? **Channel catfish**

7. What proportion of total U.S. aquaculture production does shellfish represent? **One-third**

8. What are two factors that influence support for opposition to aquaculture? **(1) Environmental impacts**

(2) Alternative uses of public waters, such as commercial fishing, recreational boating and the view from coastal property

Next, students will research and create a global “history of fishing” timeline. Initially, students should work in pairs. Each pair will choose a particular region or continent and create a timeline of fishing’s history in that location. Student pairs will then work in small groups to weave together a broader fishing timeline. The small groups will eventually all work together, in discussion with the teacher, to establish classroom consensus on a global timeline for the history of fishing. Student pairs’ timelines should, at a minimum, answer the following questions:

- When and where was the practice of fishing in your chosen location first recorded?
- What did people in that location originally fish for?
- Was there a time when fishing declined, and if so, why?
- Have there been any recent changes in fishing practices or in the popularity of fishing?
- Has aquaculture affected how people get their seafood? When and how?
- Is aquaculture the primary way seafood is made available? If so, what factors made aquaculture take off?

References:

1. Rabanal, H.R. 1988. History of Aquaculture. Lecture contributed to the Food and Agriculture Organization/United Nations Development Program. <http://www.fao.org/docrep/field/009/ag158e/AG158E02.htm>
2. U.S. Food and Agriculture Organization of the United Nations. 2018. National Aquaculture Sector Overview: United States of America. http://www.fao.org/fishery/countrysector/naso_usa/en
3. Bostock, J., McAndrew, B., Richards, R., Jauncey, K., Telfer, T., Lorenzen, K., Little, D., Ross, L., Handisyde, N., Gatward, I., and R. Corner. 2010. Aquaculture: Global Status and Trends. *Philosophical Transaction of the Royal Society B* 365: 2897-2912.
4. U.S. Department of Agriculture. 2014. 2012 Census of Aquaculture (2013), Census of Agriculture. <https://www.agcensus.usda.gov>
5. Parker, R. 2012. *Aquaculture Science*. New York: Delmar, Cengage Learning.

Lessons in Mariculture



Aquaculture History and Overview

Student Worksheet Name _____

1. In which country did aquaculture originate?
2. What was the first aquaculture species cultured?
3. How was aquaculture first used in the U.S.?
4. What percentage of world seafood supply does aquaculture represent?
5. What percentage of global aquaculture production does the U.S. represent?
6. What is the number-one aquaculture species (by value) farmed in the U.S.?
7. What proportion of total U.S. aquaculture production does shellfish represent?
8. What are two factors that influence support for opposition to aquaculture?