Aquaculture

*Lesson Plan for Grade 6 , English Language Arts & Science*

*Prepared by NAITC*

*Modified by Mississippi State University, School of Human Sciences*

*for Mississippi Farm Bureau Federation - AITC*

# OVERVIEW & PURPOSE

In this lesson, students will discover the sources of various fish and seafood, compare wild-caught and farm-raised aquaculture systems, and use a simulation to learn how overfishing can damage the ocean ecosystem.

# EDUCATION STANDARDS

**Mississippi College-and-Career Readiness Standards:**

L.6.3 Students will demonstrate an understanding of the relationships among survival, environmental changes, and diversity as they relate to the interactions of organisms, populations, and the environment.

RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others’ ideas and expressing their own clearly.

Math-6.EE.2 Write, read, and evaluate expressions in which letters stand for numbers.

**NALOs**

T1.6-8 a Compare and contrast the advantages and disadvantages involved when converting natural ecosystems to agricultural ecosystems

T1.6-8 d Discuss (from multiple perspectives) land and water use by various groups (i.e., ranchers, farmers, hunters, miners, recreational users, government, etc.), and how each use carries a specific set of benefits and consequences that affect people and the environment

T1.6-8 h Recognize the factors of an agricultural system which determine its sustainability

T2.6-8 b Explain the role of ethics in the production and management of food, fiber and energy sources

T3.6-8 i Identify sources of agricultural products that provide food, fuel, clothing, shelter, medical, and other non-food products for their community, state, and/or nation

OBJECTIVES

* Students will be able to compare and contrast different types of fish farming.
* Students will be able to define overfishing and the effects it has on the environment.
* Students will be able to describe the process of sustainable fishing.

# MATERIALS NEEDED

Activity 1:

* *Comparing Aquaculture* handout, 1 per student
* Internet access and projection ability for video clips:
  + [Harvesting Knowledge- Fish Farming](http://americasheartland.org/video/harvesting_knowledge/ah701_harvesting_knowledge_fish_farming.htm)
  + [Working the Water](https://www.americasheartland.org/watch/season-5/?episode=americas-heartland-513&start=402&end=629&title=Water+Farming)
  + [Acres and Acres of Catfish](https://www.americasheartland.org/watch/season-3/?episode=americas-heartland-311&start=772&end=1051&title=Acres+of+Catfish)
  + [Oyster Farming](https://www.americasheartland.org/watch/season-8/?episode=americas-heartland-805&start=157&end=454&title=Oyster+Farming)
    - Note that these video clips play best from Chrome.

Activity 2:

* *The Lifespan of Overfishing Student Data Table*, 1 per student
* Large box of colored Goldfish® crackers
* Per group of 4 students:
  + 1 paper plate
  + 4 napkins/paper towels
  + 4 spoons
  + 4 pieces of string
  + 4 straws
  + Access to tape

Activity 3:

* *Public Awareness Campaign Rubric*
* Poster paper, 1 per group
* Markers

Essential Links:

* [Comparing Aquaculture handout](https://cdn.agclassroom.org/media/uploads/2017/09/26/Comparing_Aquaculture_handout.pdf)
* [Public Awareness Campaign Rubric](https://cdn.agclassroom.org/media/uploads/2017/09/26/Rubric_for_Public_Awareness_Campaign_PSA_on_Overfishing.pdf)
* [The Lifespan of Overfishing Student Data Table](https://cdn.agclassroom.org/media/uploads/2017/09/29/The_Lifespan_of_Overfishing.pdf)

Lesson Set Up:

Activity 1:

* Have each of the video clips already loaded on the computer for easy access when it is time to watch them.
* Have copies of the [Comparing Aquaculture handout](https://cdn.agclassroom.org/media/uploads/2017/09/26/Comparing_Aquaculture_handout.pdf) ready to hand out to each student.

Activity 2:

* Have a large box of colored Goldfish® crackers ready to use during this activity.
* Have students divided into groups of four.
* Have copies of the [The Lifespan of Overfishing Student Data Table](https://cdn.agclassroom.org/media/uploads/2017/09/29/The_Lifespan_of_Overfishing.pdf) ready to hand out to each student.
* Have one student from each group collect the following supplies:
  + 1 paper plate
  + 4 napkins/paper towels
  + 4 spoons
  + 4 pieces of string
  + 4 straws
  + Tape

Activity 3:

* Have copies of the [Public Awareness Campaign Rubric](https://cdn.agclassroom.org/media/uploads/2017/09/26/Rubric_for_Public_Awareness_Campaign_PSA_on_Overfishing.pdf) ready to hand out to each student.

# Vocabulary

**aquaculture:** the cultivation of aquatic organisms (such as fish or shellfish) especially for food

**bivalve mollusk:** aquatic mollusk whose body is enclosed in a hinged shell such as oysters, clams, mussels, and scallops

**crustacean:** a type of animal (such as a crab or lobster) that has several pairs of legs and a body made up of sections that are covered in a hard, outer shell

**fish farm:** a place where fish are artificially bred or cultivated for food, restocking lakes for angling, or to supply aquariums

**mollusk:** a type of invertebrate animal (such as snails, clams, or squids) that has a soft body, does not have a backbone, and that usually lives in a shell

**overfishing:** to fish to the detriment of a fishing ground or to the depletion of a kind of organism

**seafood:** shellfish and sea fish served as food

**sustainability:** relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged

**wild-caught:** taken from the wild rather than being bred from domestic stock

# Ag Facts:

* Shrimp is the number one consumed seafood in the United States. Canned tuna and salmon are second and third.
* In the United States the term *seafood* refers to all edible aquatic life and can include both salt-water and fresh-water species.
* USDA’s MyPlate dietary guidelines recommend two servings of seafood per week.
* 35,100 acres of catfish production in Mississippi in 2020.
* 205 catfish operations in Mississippi in 2020.
* Catfish production was a $172 million commodity in Mississippi in 2020.

# Background Information for Teacher:

**Seafood** (fish and shellfish) are a nutrient-dense source of dietary protein. Compared to other sources of protein, seafood is low in calories and saturated fat and rich in key nutrients including zinc, magnesium, phosphorous, potassium, and vitamins A, B12, and D. Seafood is also a primary food source of omega-3 fatty acids, EPA, and DHA. The American Heart Association and the Dietary Guidelines for Americans recommends eating two, 3.5 ounce servings of fish per week.

The seafood we purchase at retail markets can come from a variety of sources. **Aquaculture** is the farming of aquatic organisms such as fish, **crustaceans**, **mollusks**, and aquatic plants. **Fish-farming** can involve raising fish commercially in tanks or other man-made enclosures such as ponds or concrete fish runs. These farms manage their water (flow, oxygen levels, etc.) and the growth of fish from the fertilization of eggs until harvest. Other fish farms follow similar principles, but use a cage system in a natural water source such as a lake or ocean. These farms use the same water and habitat as wild fish, but keep their fish in separate enclosures. Regardless of the type of system, it is considered a *farm* if humans manage the breeding, feeding, and growth of the fish. In the United States, trout and catfish are the most commonly farmed fish species. World-wide, the seafood most commonly farmed are shrimp and salmon.

Some of the seafood we eat is supplied through fishing. This seafood is usually labeled as **wild-caught** and is harvested using nets, trawls, or other devices. Wild harvest commercial fishermen work closely with government agencies to help ensure that wild stocks are not **overfished** in US waters. The National Marine Fisheries Service identifies areas considered essential to living marine resources and regulates the use of these areas so that the habitats remain healthy, sustainable, and productive. Although many waters are managed through quotas on the number of fish that can be caught and restrictions on the size of fish that can be harvested, the breeding, feeding, and growth of the fish are not managed by humans in any way.

Many species of fish and shellfish can be raised on farms or caught from the wild. The dietary value of fish resulting from both (farmed or wild-caught) production methods is equal. In addition to a dietary comparison, a look at the environmental impacts of each system is critical to maintaining the long-term **sustainability** of fish farming and wild-caught fisheries. It is estimated that wild-caught fisheries have reached their maximum sustainable yield, while the world's appetite for seafood is growing.

One solution to this challenge is the aquaculture industry, which can satisfy the growing demand for seafood in an environmentally friendly and sustainable manner. US aquaculture operations raise fish such as trout, tilapia, barramundi, and cobia that can replace more familiar species on menus yet still meet customers' wants and needs. Other farms are raising traditional marine species such as cod, flounder, and halibut. The availability of these species from farms allows consumers to access their favorite seafood while wild fish stocks recover.

Another example of aquaculture providing positive environmental impacts is the production of **bivalve mollusks**, such as clams, oysters, and mollusks. These shellfish remove nutrients from the water by feeding on algae and particulate matter. This helps maintain good water quality and minimizes the loss of critical oxygen. While farmed shellfish are growing, they spawn and help to reseed wild shellfish beds. Due to their unique structure, bivalve mollusks provide habitats and hiding places for other organisms, adding to the biodiversity of the marine ecosystem. These impacts are so important that, in some areas, community volunteers are restoring oyster and clam populations.

# LEARNING PROCEDURES

Interest Approach:

1. Tell your students to imagine they are walking through the grocery story in the meat department and they come across the seafood section. Ask, "What kind of meat do you expect to be here?" *(Students may list any seafood item they are familiar with such as shrimp, crab, lobster, and various fish such as salmon, trout, haddock, halibut, etc.)*
2. Ask students, "Where did this meat come from?" As they offer answers, guide them to the question, "Did it come from a farm?"
3. Continue the discussion by asking if there is a difference between fishing and farming. Some specific questions to guide your discussion might be *What is farming?*, *What is fishing?,* *How are fishing and farming different/the same?*, *Is the fish you eat from a farm or from the ocean?*
4. Share the *Did You Know?* *Ag Facts* listed in the lesson. Clarify the definition of *seafood* and inform students that in this lesson they will be learning about a variety of seafood including fish, shellfish, and crustaceans.



Activity 1: Sourcing Fish and Seafood

1. Ask students if they can guess how long fish has been part of our diets in human history. Show the [Harvesting Knowledge- Fish Farming](https://youtu.be/P5F2pvi2bJI) video clip from America's Heartland to answer the question. After the video, ask students, "How do we get these fish from the water to our plates?"
2. Give each student one copy of the *Comparing Aquaculture* handout. Using the back side of the handout as a guide, describe three different methods of harvesting fish and seafood for human consumption.
3. Inform students that they will be taking a video tour of the three different methods. As they watch each video clip, they should fill out the Venn diagram noting the differences and similarities found while comparing each system.

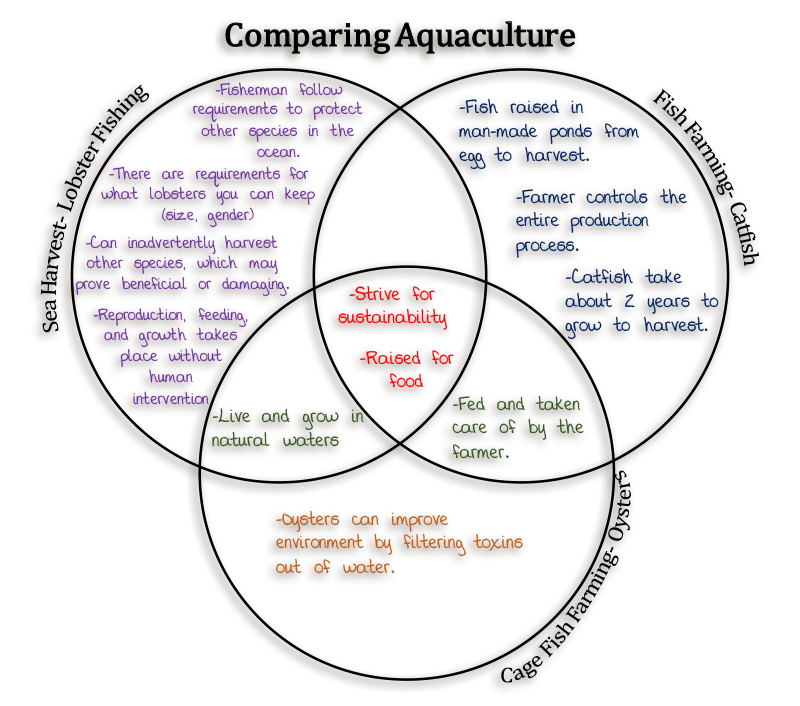
* **Note:** If students are not familiar with Venn diagrams, give additional instructions describing what each portion of the circle represents.

1. Show the following video clips:

* Wild-Caught Fishing: [Working the Water](https://youtu.be/iEXGEm8MA8A) (lobster fishing)
* Fish Farming: [Acres and Acres of Catfish](https://youtu.be/uhKtQ1Rlx3o)
* Cage Fish Farming: [Oyster Farming](http://www.americasheartland.org/episodes/episode_805/oyster_farming.htm)

1. After watching the videos, have a class discussion to summarize what students learned. Point out to students that not all the lobsters we eat are wild-caught and not all oysters and catfish are farmed. Lobsters can be farm-raised and oysters and catfish can be wild-caught. Use the following questions to help guide their comparisons and complete their Venn diagrams:

* Where do the fish/seafood shown in the videos live? *(lobsters and oysters live in natural waters, catfish live in man-made waters)*
* Where do the fish/seafood shown in the videos get their food? *(lobsters eat from the ocean, oysters and catfish are fed by farmers)*
* Which method is regulated by what type of animals can be harvested? *(Wild-caught fishing. In order to manage the populations of wild lobsters, fishermen must follow specific requirements to maintain a healthy population of lobsters and protect other species.)*
* Which method has the potential for harming other populations of animals? *(Wild-caught fishing. The fishing process could inadvertently harvest or harm other species. You can also note that in some cases invasive species can be better managed to improve the ecosystem through fishing practices.)*
* Which fish/seafood shown in the videos were completely reliant upon farmers to manage breeding, feeding, and growth? *(oysters and catfish)*
* Which method has the goal of producing a food product for human consumption? *(all three)*
* Which method strives for sustainability? *(all three)*

Activity 2: The Lifespan of Overfishing 

1. Now that students have a basic knowledge of a few methods used to produce and harvest fish and seafood, inform them that this activity will focus on an ecological issue with wild-caught fish.
2. Review the basic concepts of a food web. Give examples if needed to help students recall that a food web is a system of interlocking and interdependent food chains. Ask students to give examples of food chains and webs that can be found in an ocean.
3. Introduce the activity by telling students that they will be simulating an ocean food web using colored goldfish crackers. Explain that in this ocean’s food web the plain yellow goldfish eat seaweed of which there is always plenty, the green goldfish and red goldfish eat the yellow goldfish, and the dark orange goldfish eat both green goldfish and red goldfish.
   1. Note that there must be at least two goldfish in the ocean for these fish to survive. However, you may or may not want to share this with the students immediately.
4. Inform the students that in addition to its place in the food web, each fish also has a dollar value, and the purpose is to earn money. If the fish are harvested, each yellow goldfish will make a profit of $2, red goldfish will make a profit of $5 each, green goldfish will make a profit of $5 each, and dark orange goldfish will make a profit of $10 each.
5. Organize students into groups of four. Give each student one copy of *The Lifespan of Overfishing Student Data Table*. Have one person from each group collect the following supplies:
   1. 1 plate
   2. 4 spoons
   3. 4 straws
   4. 4 napkins
   5. 4 pieces of string
   6. 1 roll of tape
6. At the start of the activity, put 8-10 of each color of goldfish into each group's ocean (paper plate). (Numbers can be adjusted as the teacher sees fit.) Have the students record the number of each fish in the "Year 1 Start" column of their data table.
7. When all the oceans are stocked and fishing poles are made, give the students 30 seconds to fish. At the stopping signal, all fishing poles must be put down.
8. Tell the students to fill in their data tables for "Year 1 End" with the number of each species of fish that remains in their ocean. Record the value of their catch in the "Year 1 Income" column. Any fish remaining on the table, still attached to the fishing pole, or destroyed during fishing do not count. Once their tables are filled out, the students can eat the goldfish they caught.
9. Adjust the number of fish in each ocean to account for reproduction by adding one new fish of each species for each two that remain. Keep in mind that there must be a food source for each species to allow for survival. If no food source remains, remove that species from the ocean.
10. Repeat steps 6-8 three more times until there have been four years of fishing.
11. Instruct the students to use their data to create a line graph showing the changes in their fish population over time.
12. Have each group report to the class the final number of fish remaining in their oceans after year four. Some oceans may be completely empty of fish. Others may have established a way to fish sustainably so that there are more fish than when they started. Discuss the various strategies the different groups used (or didn't use) to manage their oceans.
13. As a class, discuss the following questions:
    1. What is overfishing?
    2. Why does overfishing happen?
    3. What are the effects of overfishing?
    4. What is stewardship and why is it important?
    5. How can the world continue to fish in a sustainable manner?

Activity 3: Public Service Announcement

1. Give each student 1 copy of the *Public Awareness Campaign Rubric*. Divide students into groups to complete. Tell students they will be creating a Public Service Announcement (PSA) Poster encouraging the community to eat fish sustainably. PSAs are messages in the public interest. They can be found on television, radio, print or other media. PSAs are different from commercial advertising. Rather than marketing a product or service, PSAs are messages that benefit the public by raising awareness of an issue and influencing attitudes or actions for the good of mankind.
   * Optional adaptation: Rather than completing an entire poster, this activity can be adapted for individual student work by assigning students to make a flyer or educational brochure.
2. In preparation for creating the PSA, have students research aquaculture using some of the following resources:
   * Book: *World Without Fish* by Mark Kurlansky
   * Brochure: [United States Aquaculture Fact and Fiction](http://thenaa.net/pub/United-States-Aquaculture-Fact-Fiction.pdf)
   * Website: [Monterey Bay Seafood Watch](http://www.seafoodwatch.org/about-us)
   * TED Talks: “[The four fish we’re overeating- and what to eat instead](https://www.ted.com/talks/paul_greenberg_the_four_fish_we_re_overeating_and_what_to_eat_instead)” and “[The case for farm fishing](https://www.ted.com/talks/mike_velings_the_case_for_fish_farming)”
3. Possible poster prompts teachers may use to guide students are:
   * Why is seafood a healthy protein source?
   * Why is overfishing a problem?
   * Why is farm raised fish a healthy option?
   * What is sustainable fishing?
   * Why is aquaculture considered a future food source?
4. After projects are complete, have students present posters with the class or share via gallery walk.

**Concept Elaboration and Evaluation**

After conducting these activities, review and summarize the following key concepts:

* Fish and seafood provide a healthy source of protein and vitamins. USDA dietary recommendations encourage eating fish and seafood twice per week.
* Fishing open waters for the harvest of fish and other seafood requires close monitoring to prevent damage to the ocean ecosystem and to ensure the animal populations remain healthy and sustainable for the future.
* There are both benefits and drawbacks to converting natural ecosystems (oceans and other natural waters) into agricultural ecosystems (fish farms).

Additional Learning Procedures

To help students review and elaborate more about aquaculture, try using the [“The Carousel”](https://drive.google.com/file/d/1suErrkDjKRLue9SkQp-LRHgMr_Febbss/view?usp=drive_link) method to allow students to think deeper and make new connections.

Additional Things to Consider:

[Food for the Future](https://agclassroom.org/matrix/resource/1276/)

[Producing Fish](https://agclassroom.org/matrix/resource/994/)

[George the Farmer](https://agclassroom.org/matrix/resource/1147/)

[How Do You Grow a Fish Sandwich?](https://agclassroom.org/matrix/resource/814/)



Source: <https://www.agclassroom.org/teacher/matrix/>

*For more information and additional lessons visit*

*https://msfb.org/ag-in-the-classroom/lesson-plans/.*