Aquaculture

Grade Level(s)

Middle School

Estimated Time

Min: 30-45 minutes Max: couple of hours depending on how in-depth you would like to go.

Purpose

Students will discover the sources of various fish and seafood and compare wild-caught to farm-raised aquaculture systems.

Materials

- Links:

  Website with our virtual resources: www.linncoag.com -2020/21 virtual-drop down tab-December.

  Instructional video: https://www.youtube.com/watch?v=Wye_-gxeNqc

  Local fish FarmChat: Eagle's Catch Tilapia
  https://www.youtube.com/watch?v=8EA04bxH7uk

  Comparing aquaculture system videos

  Harvesting Knowledge- fish farming:
  http://americasheartland.org/video/harvesting_knowledge/ah701_harvesting_knowledge_fish_farming.htm -

  Working the Water:
  https://www.americasheartland.org/episodes/episode_517/working_the_water.htm

  Acres and Acres of Catfish:
  https://www.americasheartland.org/episodes/episode_311/acres_of_catfish.html

  Oyster Farming:
  https://www.americasheartland.org/episodes/episode_805/oyster_farming.htm

- Worksheets:

  Comparing aquaculture systems

  Lifespan table

- Other:

  Plates

Napkins

Tape

Spoons

String

Straws

Colored goldfish

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

Interest Approach – Engagement

1. Tell your students to imagine they are walking through the grocery store 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?*

Background - Agricultural Connections

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.[5]

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.[6]

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.

Procedures

1. Watch the instructional video provided above
2. Pass out the comparing aquaculture worksheet and begin playing the videos, instruct the students to take notes while watching. Begin with Harvesting Knowledge-Fish Farming.

3. Watch the 3 aquaculture system videos- review as a class what the students wrote in their Venn-diagrams (the videos might play best from Chrome).
4. The lifespan of overfishing- now that the students have an overview of different fish systems, it is time to look at the ecological issue of overfishing wild fish.
5. 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.
6. 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. **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.
7. 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.

8. 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 plate
    4 spoons
    4 straws
    4 napkins
    4 pieces of string
    1 roll of tape
9. 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.

10. 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.
11. 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.
12. 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.
13. Repeat steps 6-8 three more times until there have been four years of fishing.
14. Instruct the students to use their data to create a line graph showing the changes in their fish population over time.
15. 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.
16. As a class, discuss the following questions:
    What is overfishing?
    Why does overfishing happen?
    What are the effects of overfishing?
    What is stewardship and why is it important?
    How can the world continue to fish in a sustainable manner?
17. Watch the local Fish FarmChat- Eagle's Catch (video link above) to recap lesson.

Organization Affiliation

Original lesson plan can be found on the National Ag in the Classroom website: Overfishing and Aquaculture (grades 6-8).

Agriculture Literacy Outcomes

Agriculture and the Environment

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.d)

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

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

Food, Health, and Lifestyle

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

Plants and Animals for Food, Fiber & Energy

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

Iowa/ Common Core Standards

Career & Technical Education (CAREER)

Natural Resource Systems Career Pathway

NRS.01.02 Classify different types of natural resources in order to enable protection, conservation, enhancement and management in a particular geographical region.

NRS.01.04 Apply ecological concepts and principles to aquatic natural resource systems.

NRS.02.02 Assess the impact of human activities on the availability of natural resources.

Science (SCIENCE)

MS-ESS3: Earth and Human Activity

MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.