



NOAA FISHERIES

Grade Level
9-12

Materials

- Computer with Internet access
- Notecards for each group

Audio/Visual Materials

- Projector
- Computers with Internet (one for each group of students)

Teaching Time

Two to Three 45-minute class periods

Seating Arrangement

Groups of three or four

Key Words

- Aquaculture
- Crustacean
- Endangered Species

Fish Farming: What would you decide?

For use with Fish Watch at www.fishwatch.gov



Focus

- Fisheries stakeholders

Focus Questions

- What is aquaculture?
- What are the benefits and challenges of aquaculture in the U.S.?

Learning Objectives

- Define aquaculture and describe its benefits and challenges.
- Explain the different perspectives of fisheries stakeholders on aquaculture.

Background Information

Aquaculture -- also known as fish or shellfish farming -- refers to the breeding, rearing, and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes, and the ocean. Researchers and aquaculture producers are farming all kinds of freshwater and marine species of fish and shellfish. Aquaculture produces food fish, sport fish, bait fish, ornamental fish, crustaceans, mollusks, algae, sea vegetables, and fish eggs.

National Science Education Standards *Grades 9-12*

Content Standard E: Science and Technology

- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives

- Natural Resources
- Science and technology is local, national, and global challenges

Ocean Literacy Essential Principles

Essential Principle 5

The ocean supports a great diversity of life and ecosystems.

Fundamental Concept a

Ocean life ranges in size from the smallest virus to the largest animal that has lived on earth, the blue whale.

Essential Principle 6

The ocean and humans are inextricably connected.

Fundamental Concept b

From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our economy, serves as a highway for transportation of goods and people, and plays a role in national security.

Fundamental Concept e

Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and

Approximately half the seafood eaten worldwide – including in the United States – is farm-raised. Because harvest from many wild fisheries has peaked globally, aquaculture is widely recognized as an effective way to meet the seafood demands of a growing population. As a result, aquaculture is the fastest growing form of food production in the world.

Marine vs. Freshwater Aquaculture

Researchers and the aquaculture industry are farming all kinds of freshwater and marine species of fish and shellfish.

- Marine aquaculture refers to raising species that live in the ocean, including oysters, clams, mussels, shrimp, and salmon.
- Freshwater aquaculture produces species that are native to rivers, lakes, and streams, such as trout, catfish, tilapia, and bass.

Other Uses for Aquaculture

Aquaculture has other uses besides supplying seafood. It can be used to:

- Restore habitat.
- Enhance wild fish stocks such as salmon.
- Produce baitfish.
- Rebuild populations of threatened and endangered species.
- Culture fish for zoos and aquariums.
- Produce plant species for use in a range of food, pharmaceutical, nutritional, and biotechnology products.

Impacts of Aquaculture

Sustainable marine aquaculture has many benefits. For example, aquaculture creates employment and business opportunities in coastal communities, provides safe and sustainable seafood, and supports marine fish populations and habitats.

Like any human activity, aquaculture can impact the environment, which is why U.S. aquaculture operators adhere to strong environmental and food safety regulations. When practiced responsibly, aquaculture's impact on wild fish and shellfish populations, marine habitats, and water quality is minimal. In fact, aquaculture can benefit the ecosystem – for example, oyster aquaculture creates habitat and enhances water quality. NOAA continues to work with our partners to develop innovative techniques and management practices that ensure we're protecting our marine ecosystems as aquaculture production expands around the world.

U.S. Aquaculture

Farmed trout, tilapia, and catfish make up about 70 percent of all the U.S. aquaculture. The most common U.S.-farmed marine species are shellfish, including oysters, mussels, and clams. Those 'mollusks' make up two-thirds of the total U.S. marine aquaculture production followed by salmon (about 25 percent) and shrimp (about 10 percent). Ornamental fish and plants displayed in public and private aquariums are also grown in U.S. aquaculture facilities.

activity leads to pollution and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

Fundamental Concept g

Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean.

Essential Principle 7

The ocean is largely unexplored.

Fundamental Concept c

Over the past 40 years, use of ocean resources has increased significantly; therefore, the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations.

Proponents and Opponents of Aquaculture

Like any technology, aquaculture has pros and cons. A well-sited and managed operation has a small environmental footprint. A poorly-sited and managed farm can cause problems.

Proponents believe that – when sited and managed well – aquaculture creates jobs, help preserve coastal communities, relieve fishing pressure on wild stocks, and provide affordable protein. They also see aquaculture boosting endangered species and habitat restoration.

Opposition to aquaculture is driven by a number of concerns. And, since many people don't know where their seafood comes from, myths and misperceptions are big challenges. Opposition to aquaculture in the United States is usually rooted in concern over the siting of farms and the potential for disease and excess nutrients to adversely affect the environment and other species. The use of drugs and chemicals in aquaculture – something that is closely regulated in the United States and in some countries – is also a concern. In addition, the belief that an aquaculture facility can lower the aesthetic value of a coastline or water body is also a concern. All of these concerns are valid and – with the appropriate techniques and safeguards in place – can be addressed.

Economics

Right now, the United States is a major consumer of aquaculture products. We import 84% of our seafood and half of that is from overseas aquaculture. That trade imbalance leads to an annual seafood trade deficit of over \$9 billion. U.S. aquaculture (freshwater and marine) supplies about 5 percent of the U.S. seafood supply and U.S. marine aquaculture less than 1.5 percent. Many other countries are investing more heavily in aquaculture than the United States. According to the United Nations Food and Agriculture Organization report *The State of World Fisheries and Aquaculture*, the United States ranks 13th in global aquaculture production behind China, India, Vietnam, Indonesia, Thailand, Bangladesh, Norway and others. From a jobs perspective, aquaculture is beginning to be viewed as another approach to seafood harvesting by some commercial fishermen who use it to complement their wild harvest operations.

Sources:

- NOAA FishWatch
www.fishwatch.gov
- The State of World Fisheries and Aquaculture 2010
www.fao.org/docrep/013/i1820e/i1820e00.htm
- NOAA Aquaculture Program
aquaculture.noaa.gov/

Learning Procedure

1. Ask students what they think the term "aquaculture" means. Explain to the class that almost half the seafood globally is grown on farms rather than caught wild in oceans, lakes, or rivers.

2. Show students the 3-minute video "Ocean Today: Fish on a Farm" at oceanoday.noaa.gov/fishonafarm/ Other aquaculture resources can be found at www.nmfs.noaa.gov/aquaculture/library/aq_video_gallery.html. Discuss their reactions to the video(s), and share with them the background information provided in this lesson.

3. Tell students that they are going to participate in a town meeting to decide whether an aquaculture facility should be built in their town. The facility will be located along a coastal waterway, and will grow oysters. The facility will generate fifty jobs and lower taxes in the town. The facility owners will sell their product to local restaurants and markets. (Teachers may add other relevant pieces of information to the scenario based on the information on oysters on for Fish Watch website.)

4. Divide students into small groups of three or four, and assign them a role to play (as a group). Roles can vary, but should include stakeholders such as seafood restaurant owner, fisheries scientist, aquaculture facility owner, seafood market owner, and town resident.

5. Students should think about the impacts of an aquaculture facility from the point of view of their assigned role. They should visit the following web sites and review the videos above to learn more about aquaculture:

- www.fishwatch.gov/farmed_seafood/aquaculture_faqs.htm (and species pages)
- www.nmfs.noaa.gov/aquaculture/index.htm

6. As a group, have students make a list of pros and cons for building facility from the perspective of their role. Give students 20-30 minutes to prepare their positions for the debate.

7. Students may make note cards with key points on them. They should select one person from their group to be the "spokesperson" who will represent them at the meeting. Tell each group they will have three minutes to present their case for or against the aquaculture facility.

8. Allow the spokesperson from each group to come to the front of the class and present the group's position or have each member of the group present one part of the opinion. Remind students that courtesy and professionalism should be practiced.

9. When all groups have presented, have a final class vote on whether the aquaculture facility should be approved. Discuss the reasons for their decision, and how their opinions might change if they were representing a different stakeholder.

The Bridge Connection

www.vims.edu/bridge

In the search box on the main page, type in "aquaculture" for a list of resources which focus on aquaculture.

The “Me” Connection

Have students write a one-page essay or journal entry on how they think aquaculture impacts them and their families.

Connections to Other Subjects

Environmental science, Economics

Evaluation

Monitoring of group discussions, and town meeting presentations allow opportunities for assessment.

Extension

Have students interview their local grocery store seafood counter managers and ask where the store gets its fish and shellfish from, and if it is farm-raised or wild caught. Or, go to a local restaurant and ask the manager where the restaurant gets its fish and shellfish from and if they are farm-raised or wild caught. Make a list showing the species they sell/prepare and where they came from. Students can compare the prices of the wild-caught and farmed seafood and report their findings back to the class. They can also research the species on Fish Watch.

Additional Resources

NOAA FishWatch
www.fishwatch.gov

The State of World Fisheries and Aquaculture 2010
www.fao.org/docrep/013/i1820e/i1820e00.htm

NOAA Aquaculture Program
aquaculture.noaa.gov/

Video: Ocean as a Lab: Fish Farms
oceantoday.noaa.gov/oceanasalab_fishfarms/

Time Video: Teach a Man to (Farm) Fish
www.time.com/time/video/player/0,32068,1042439336001_2082000,00.html

Video: Shellfish Growers’ Farming the Tidelands
www.youtube.com/watch?v=b212PVHOnQ8&feature=youtu.be.

NOAA Aquaculture Fact Sheet
www.noaa.gov/factsheets.html

World Food and Agriculture Organization
www.fao.org/fishery/aquaculture/en