



SeaKeepers K-12 Curriculum **Sustainable Aquaculture**

THE INTERNATIONAL
SEAKEEPERS
SOCIETY

SeaKeepers K-12 Curriculum

Lesson 6: Sustainable Aquaculture



Grade Level: 9-12

Estimated Time: 95 min

Lesson Overview:

Our oceans are a vital life source. They regulate our climate, are the largest carbon sinks, provides livelihoods to billions worldwide and supports the greatest abundance of life on our planet. A healthy ocean is essential for all organisms on Earth.

Additionally, seafood is the largest traded food commodity in the world, providing sustenance to billions of people in the world. Approximately 3 billion people rely on wild-caught and farmed seafood as a primary source of protein. However, that has led to a rise in issues such as illegal fishing and overfishing. It is estimated that 85% of marine fish stocks are overfished and fully exploited.

Hence, this has led to the increased development of aquaculture. Aquaculture is the culturing of aquatic life under controlled conditions such as ponds, enclosures and coastal areas. It is a method that is said to promote sustainability for producing food products and repopulating endangered species. However, there are many challenges faced with ensuring sustainable aquaculture, hence in this lesson plan, students shall learn about the benefits and limitations of aquaculture. They will then need to evaluate whether aquaculture is an effective method in ensuring sustainability of our marine life or if the disadvantages outweigh the benefits.

Lesson Breakdown:

- Presentation about topic ([PDF here](#)) (30 minutes)
- Summary video about topic ([Youtube video here](#)) (4 minutes)
- Activity: Cost/Benefit Analysis (60 minutes)

*Email Programming@Seakeeper.org for powerpoint file

Educational Standards Addressed:

- SC.912.L.17.20: Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability
- SC.912.L.17.17: Assess the effectiveness of innovative methods of protecting the environment.

Anticipated learning objectives:

- Understand the purpose and benefits of sustainable aquaculture
- Understand when aquaculture is not the solution to environmental concerns
- Evaluate the effectiveness of aquaculture for a local ecosystem

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Preparation & Materials

A powerpoint presentation is included for the lesson, but feel free to use other materials you have to explain these concepts. Following the presentation, use [The Future of Ocean Farming: Innovations in Aquaculture](#) video by the National Oceanographic and Atmospheric Administration to summarize the lesson content

For the activity, students will need:

- Laptops/Phones in order to conduct research
- A4 Paper/pens
- (Optional) Ice cream sticks/Glue -> in order to construct visual of aquaculture set up

Activity instructions for teachers:

The success of creating a sustainable and commercially viable aquaculture farm is heavily dependent on the proper selection of the location chosen. The objective of this activity is to allow students to conduct critical thinking and determine whether an aquaculture farm could be successfully set up at the nearest potential body of water.

1. In preparation for this activity, students should use phones or laptops to conduct the research process.
2. The students should search for the nearest body of water in which a potential aquaculture farm could be set up. This could include marine water environments (seas, oceans, bays etc) or freshwater environments (rivers, ponds, wetlands, lakes etc).
3. After which, students will be given 45 minutes to conduct research about the chosen water body and determine the benefits and the limitations of setting up a sustainable aquaculture system there.
4. Students may get as creative and as in depth as they would like and may even provide drawings or create structures of the potential set up. This would enable them to better envision how the aquaculture farm would be set up and what should be incorporated to ensure its sustainability.
5. To help guide students in making this challenging decision, we have provided a guide to help with potential considerations.
6. Students can either write down or type out their benefits vs limitations list and after which, can consider whether the benefits outweigh the limitations. They will need to make a final decision in whether the aquaculture system could be set up and be able to explain how and why they came to their conclusion.
7. After which, students can each present their findings and conclusions to the rest of the class.

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Cost/Benefit Analysis Guidelines

Sustainable aquaculture is a great way to reduce overfishing and exploitation of fish stocks. However, aquaculture is not always the best solution - in this exercise, your class will evaluate a local body of water and determine what stocks, if any, might be suitable and beneficial for your area. Examples of what you might consider in your analysis are outlined below.

A. Ecological Factors

- Water supply
- Water quality (Presence of oxygen, turbidity of the water etc)
- Climate (Monthly Temperature, rainfall, pH of the water , wind speed and direction etc)
- Potential Hydrological hazards (Data for coastal storm surges, tsunamis, cyclones etc)
- Surrounding environment (Is the land surrounding suitable? Is there a surrounding wasteland that may pollute the aquaculture set up? Is it adjacent to heavily populated areas or industrial set ups?)
- Impact of the system (How will you ensure the aquaculture farm does not add excess nutrients and fish waste into the ecosystem? How will the ecosystem remain balanced with the addition of the chosen culture species?)

B. Biological Factors

- Species to be cultured (What species is sustainable and able to survive in the type of water chosen? Does the cultured species help to reduce pressure on overexploited wild stocks?)
- Impact on the biological ecosystem (Does it result in mangrove deforestation? Does it pollute the surrounding environment? Will there be species interbreeding? Will it cause harmful effects on the natural food chain of the area?)
- Estimated size of area required

C. Economic and Social factors

- Land regulations and rights
- Availability of equipment and supplies needed to run the project (Is there a need for extensive machinery and technology? How easily accessible are some of these equipment? Will they be very expensive?)
- Availability of adequate transport infrastructure
- Availability and costs of food required to maintain aquaculture farm
- Potential resistance from locals (Consider how an aquaculture set up could effect the livelihoods of different groups of people)

Students are not required to consider all the factors listed above and may even find additional factors that they deem crucial for the set up. Hopefully, this guide will aid their research process!

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Cost/Benefit Analysis Example

Here is an example for a potential coastal aquaculture set up:

Benefits	Limitations
Aquaculture could create economic opportunities. It provides year-round job and supports coastal communities. Aquaculture could also drive employment in similar industries, such as feed and equipment maintenance/manufacturing and seafood processing.	Fishermen may object to the development of an aquaculture farm as this would affect their livelihoods. Construction of a fish farm may disrupt local fishing grounds and fish populations, or reduce the desire for wild-caught fish. These fishermen would have to adjust their jobs or find an alternative source of income.
Most fishermen in the area fish for Pacific Salmon, and as these fish are severely overfished, the aquaculture set up could help ensure their sustainability. The government could also impose laws limiting the sales of the fish, allowing populations to recover.	The coastal wetlands are crucial breeding grounds for many fish and shellfish and other species. However, setting up an aquaculture farm could result in extensive mangrove clearing and conversion to fish and shrimp ponds. This could also result in soil acidification and salinization.
Sustainable aquaculture can aid in prevention and management of aquatic pollution as it relies essentially on good-quality water resources. Aquaculture of filter-feeding animals, such as oysters or clams, can even improve local water quality.	The introduction and transfer of new species for aquaculture purposes could alter the genetic identity of the local biodiversity. This could occur due to interbreeding, competition, habitat destruction and parasite transaction.
Aquaculture can help to rehabilitate rural areas by utilizing and restoring degraded land. (especially for freshwater ponds)	There have been several incidents in which heavy rainfall resulted in algae blooms. Hence the costs of investing in technology that could monitor and regulate water quality would be costly.