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New York Sea Grant

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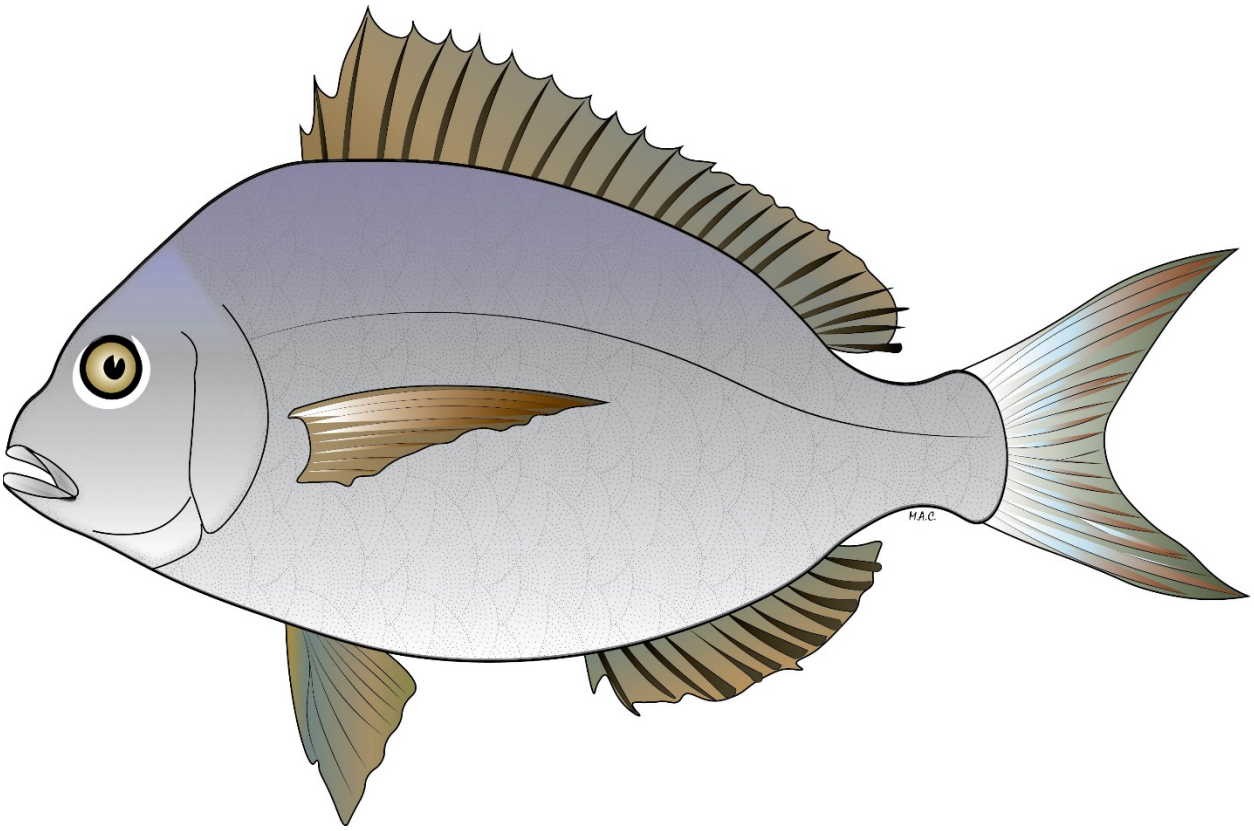
Becoming a Fish-Farmer (Aquaculturist)
NYSG Lesson Plan



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Becoming a Fish-Farmer (Aquaculturist) Lesson Plan

Grade Level(s): 7th – 12th

Time: 1.5 hours

NGSS: MSLS, MSESS: HI, HSLS, HSESS: HS, HSED

Vocab: Aquaculture, Fish, Shellfish, Seaweed, Ecosystem

Summary

The Aquaculture Modeling activity introduces the different fish-farming (aquaculture) methods that produce much of the seafood consumed throughout the world. Students will construct their own models to test the different strengths and weaknesses of different aquaculture models in terms of variables like flotation and wave intensity. It also acts as a great platform for further class discussion about these topics, which are explained in more detail in the Aquaculture Curriculum (SGAQC2017).

Objectives

After this activity, students will:

- Be able to define aquaculture (fish-farming) and have a better understanding of what it is.
- Be introduced to several aquaculture systems.
- Understand differences and trade-offs between the systems.
- Explain the key considerations an aquaculturist must address in their operation.

Materials:

Large container filled with water
Popsicle sticks
Glue
Styrofoam
Lightweight (floating) beads
Mesh netting
Wire
Twine
Pipe cleaners
Plastic straws

Optional:

Water (growing) beads
Smaller container for water

Note: Any material can be substituted based on what you have available or something additional you think may work well.

Introduction

Often referred to as fish-farming, **aquaculture is the rearing of animals and the cultivation of plants in any aquatic (water) environment**. The global production of seafood on farms (aquaculture) has been growing rapidly to meet a growing demand for seafood products. The production of fish on farms takes place in stages, which include spawning, nursery, and grow-out facilities.

Spawning is when sperm and eggs are collected from the parent fish (broodstock) and combined to fertilize the eggs.

Nurseries are the facilities or systems that the juvenile fish are held in after hatching until they grow large enough to be transferred to the larger grow-out tanks, cages, pens etc.

Grow-out operations are the systems that house the larger fish and allow them to grow to a large enough size to harvest for food.

There are many types of grow-out operations. They can be land based (flow-through or recirculating tanks, ponds, raceways) or water based (coastal cage/net pen or open ocean cages/net pens, submersible cages, surface suspension lines [shellfish] or bottom culture [shellfish]). **Appendix A** presents examples of some of the types of aquaculture. It may be a good idea to go through some of the different types of aquaculture systems with the students *after* doing the activity below.

Because fish farms are more controlled water environments it is important for the farmer to maintain the conditions of the water and meet the needs of the species of fish being grown. Some key considerations for a fish-farmer include the specific needs of the species being grown, the aquaculture system or method, the density (number) of fish in the given system, the optimal diet for a species and system, the quality of the water, and preventing or limiting the occurrence of diseases.

Activity

Step 1. Divide students into groups of 2-4.

Step 2. Read the **Background** section (below) aloud to the class.

Background

Oh NO! You were captaining a vessel across the Atlantic Ocean before striking a submerged reef! Luckily the reef borders an island and you were able to safely make it to land before your

vessel sank. You and the crew are combing through the wreckage to salvage anything you can to help you survive on the deserted island. After several weeks stranded, food stores are getting low and you need to start thinking of how you will feed your crew until help arrives. You know you are surrounded by water teaming with life, but the big fish that make a great meal are farther out at sea. Without your large vessel, daily trips on your makeshift rafts are too difficult. If you are going to survive much longer you will have to find an alternative.

On your last voyage you heard stories about a new kind of farmer, fish farmers. You remember others talking about the success of these farms and decide that if you can create your own farm on this island you can ensure that your crew are well fed until help arrives. You decide that if you can catch more than you need on one trip and keep them alive you can then hold the extra fish for another day. This will help to limit how often you need to go out fishing and give you and the crew more time to focus on creating shelter and searching for help. You even have a biologist on your crew who bred fish in the past and he thinks he could even use the fish you catch to spawn more, which you can grow to adults.

In order to construct a fish-farm, or aquaculture operation, you must build infrastructure that can contain the fish in the ocean and allow them to grow without escaping into the wild. Your job now is to use the materials you salvaged from your ship to build a structure that can hold your fish.

Step 3. Now instruct each team to build their own aquaculture model using the materials provided.

Note: It may be useful to introduce the materials and have students sketch designs for the models they plan to build. In addition to testing their predictions, this could be a way to break up this activity for multiple class periods.

Step 4. Explain that when a team finishes a model, it will be tested by the instructor in a large container of water, which represents the ocean.

Step 5. Place the model in the water. Observe for flotation. At this point you should facilitate a discussion with the students and provide some feedback or suggestions for improvements. Use the discussion questions provided below to help guide this discussion:

Discussion

Teams should be able to explain how their model would work. In their explanation, they should address the key considerations an actual fish-farmer contemplates when running their farm. The discussion questions provided below can be used to help guide students to reflect on this. The different considerations that farmers must consider when developing their farm are outlined in the Aquaculture curriculum (SGAQC2017).

- Was your farm operation successful?
- Why did/didn't it work?
- How can you fix it or what improvements can be made?

Note: You may want to open the discussion initially to the whole class, or have teams brainstorm separately and then share their approach with the rest of the class. Additionally, some questions may be more applicable in certain classes than others.

Optional Steps for Expansion

Step 6. Models that successfully float can be tested for other variables. For example:

- Resistance to wave action and storms can be simulated by shaking or rocking the bin (this would make a great activity to incorporate into a physics/engineering lesson).
- You can test how well the system holds fish by adding the water beads and seeing if they stay in the tank (with and without waves).

Step 7. Now that the students have designed their own aquaculture operations you can discuss the various methods commonly used throughout the US and world. The Aquaculture Curriculum, presentation and the illustrations in Appendix A can help demonstrate the different types of aquaculture used.

The Importance of Hatcheries: You can expand on this topic by adding the activity below, which uses the growing water beads to demonstrate fish growth and the importance of nurseries.

Step 1: Use a large mesh that the water beads (these will represent fish eggs) fall through when dry to demonstrate why eggs and small juvenile fish can't be added directly to grow-out tanks.

Step 2: Place the juveniles in a small container of water (nursery tank) and allow them to grow, representing the eggs after fertilization and hatching.

NOTE: if using this activity it is better to start this earlier on so the beads have a longer time to grow.

Step 3: Once the beads have grown you can transfer them from the nursery tank to the grow-out pen or cages the students made. This demonstrates the need for the hatchery stage in an aquaculture operation.

Step 4: Facilitate discussion around the water beads (eggs/fish) and the stages of fish farming using the discussion questions below.

- Why can't eggs be added directly into a grow-out cage system?
- How big does a fish have to be before it can be transferred to a grow-out cage/tank?
- Can you think of any other reasons why you wouldn't add eggs or small fish to an open water cage farm?

Expanded Discussion Questions: Use these questions if you would like to expand on the topics.

- What will happen to your farm operation if a storm comes? Is it built to last?
- Are there ways for the fish to escape your system? How can you prevent that from happening?
- What will the fish eat?
- How can you maintain water quality in your farm system?
- How will you prevent disease outbreaks on your farm?
- What potential effects will your operation have on the surrounding environment or ecosystems?

Resources

Sea Grant Aquaculture Curriculum – SGAQC2017.pdf

This Seafood Science curriculum was produced by NY Sea Grant with funds supporting the project and associated workshops and trainings from NOAA Sea Grant project number NA16OAR4170251 and the CALS CCE Summer Internship Program.

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Appendix A: Illustrations

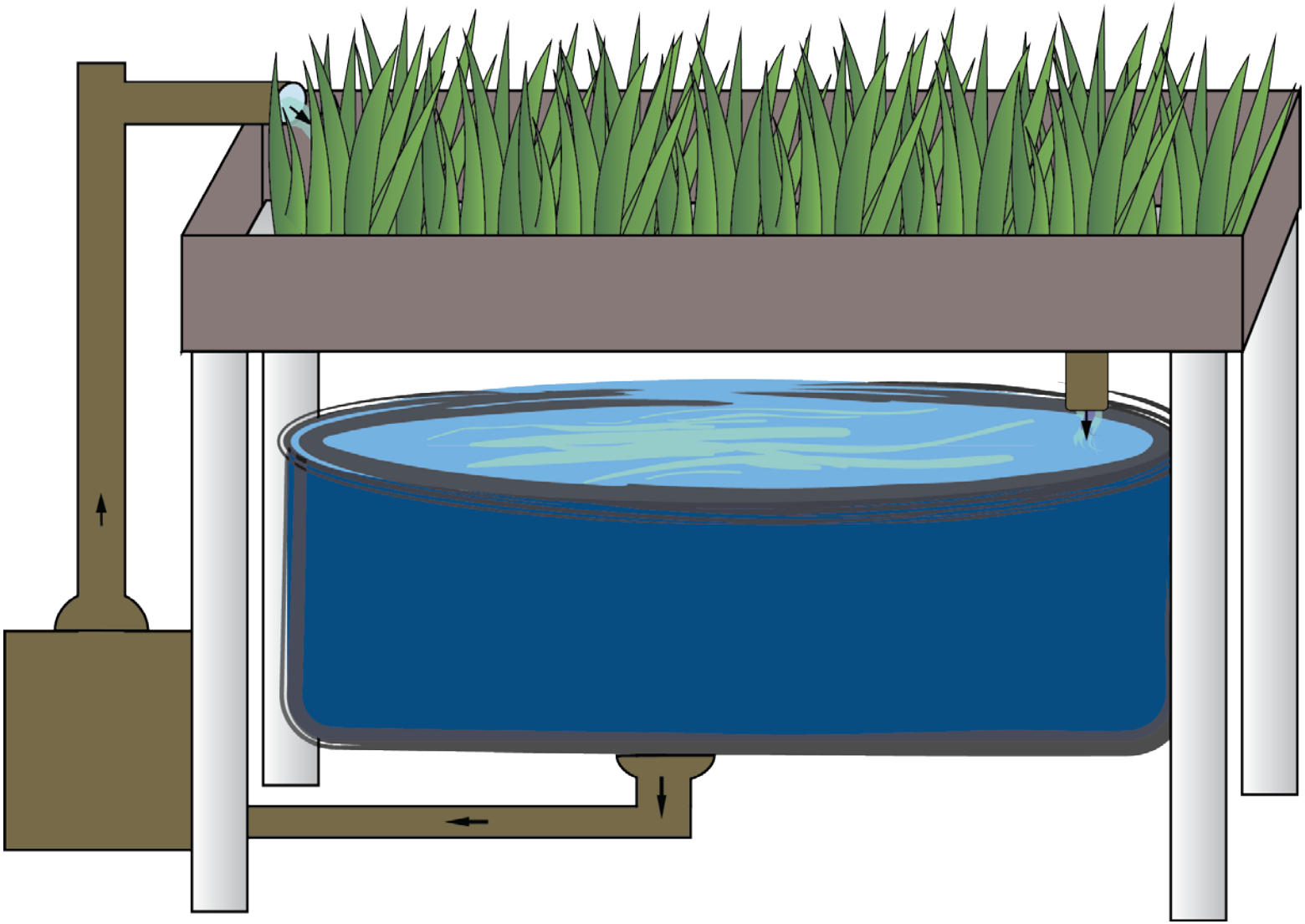


Figure 1. Example of a simple **aquaponics** system, where nutrients cycle within a culture system of fish and aquatic plants.

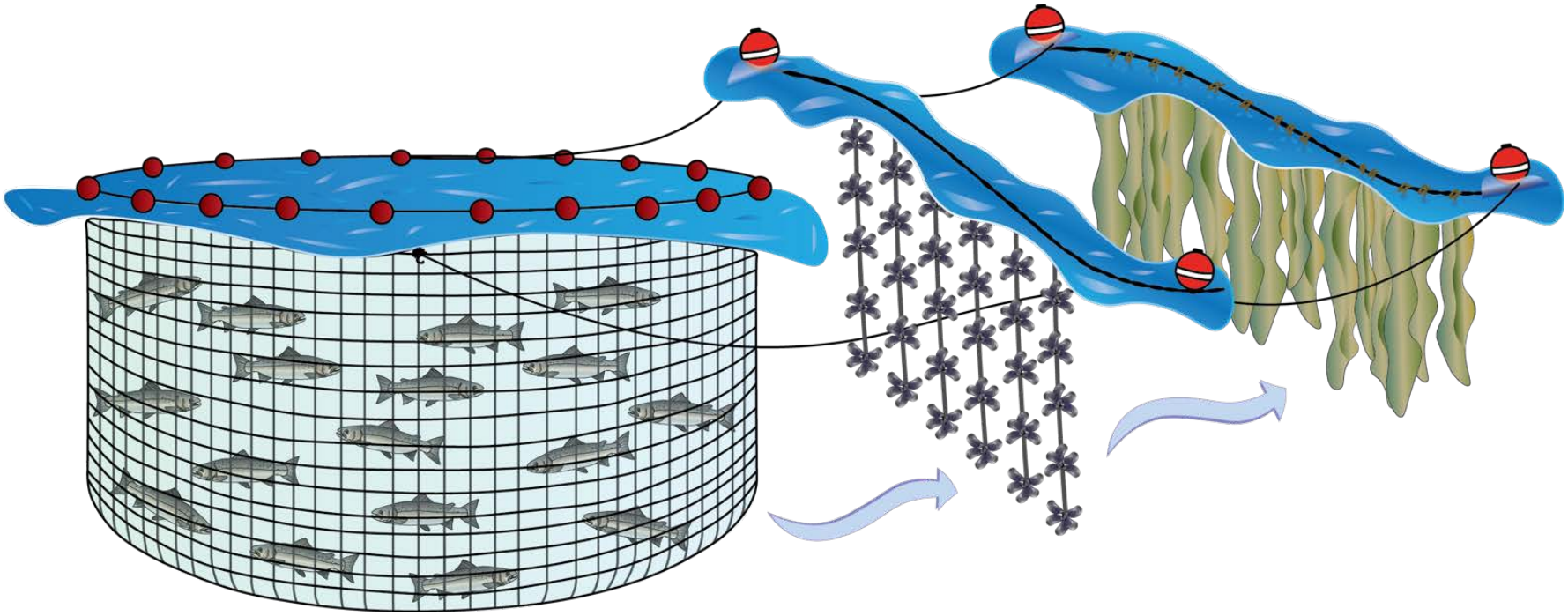


Figure 2. Example of an **integrated multitrophic aquaculture** system, where waste from one species is utilized by the other species down current.

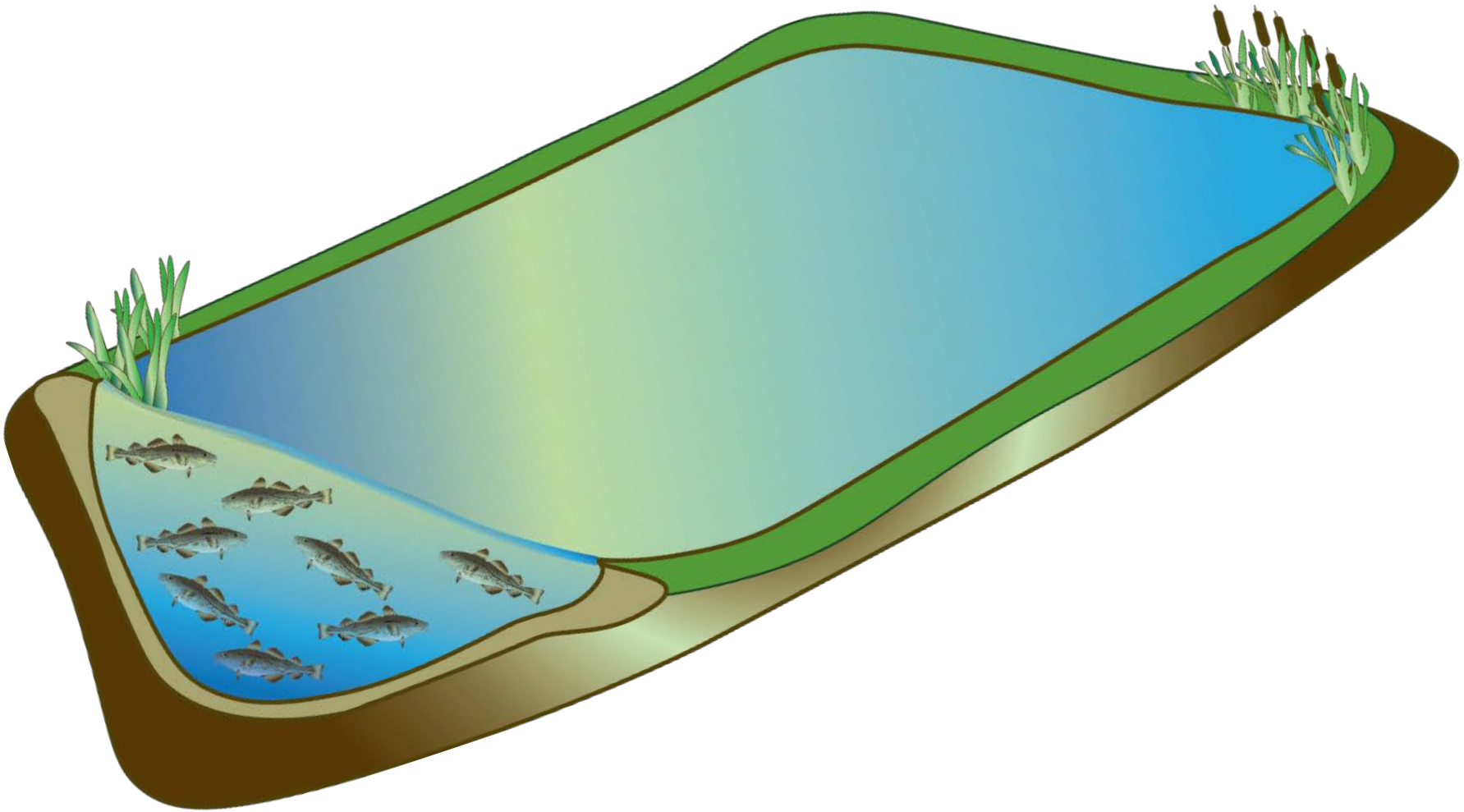


Figure 3. Example of an earthen **pond** system.

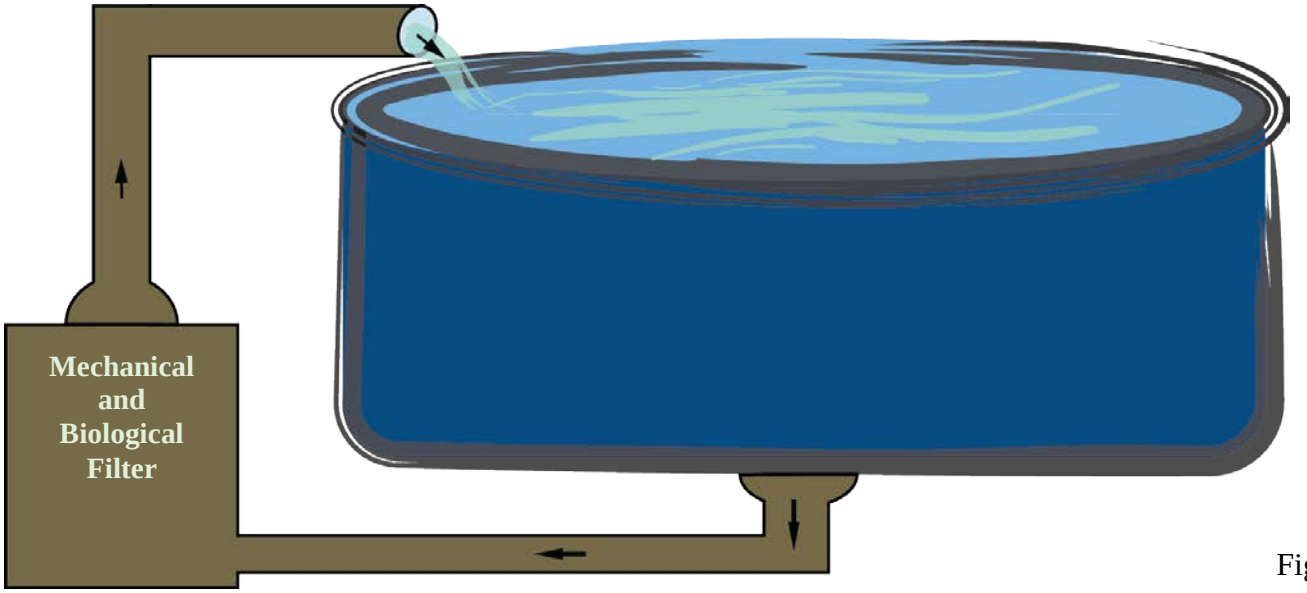
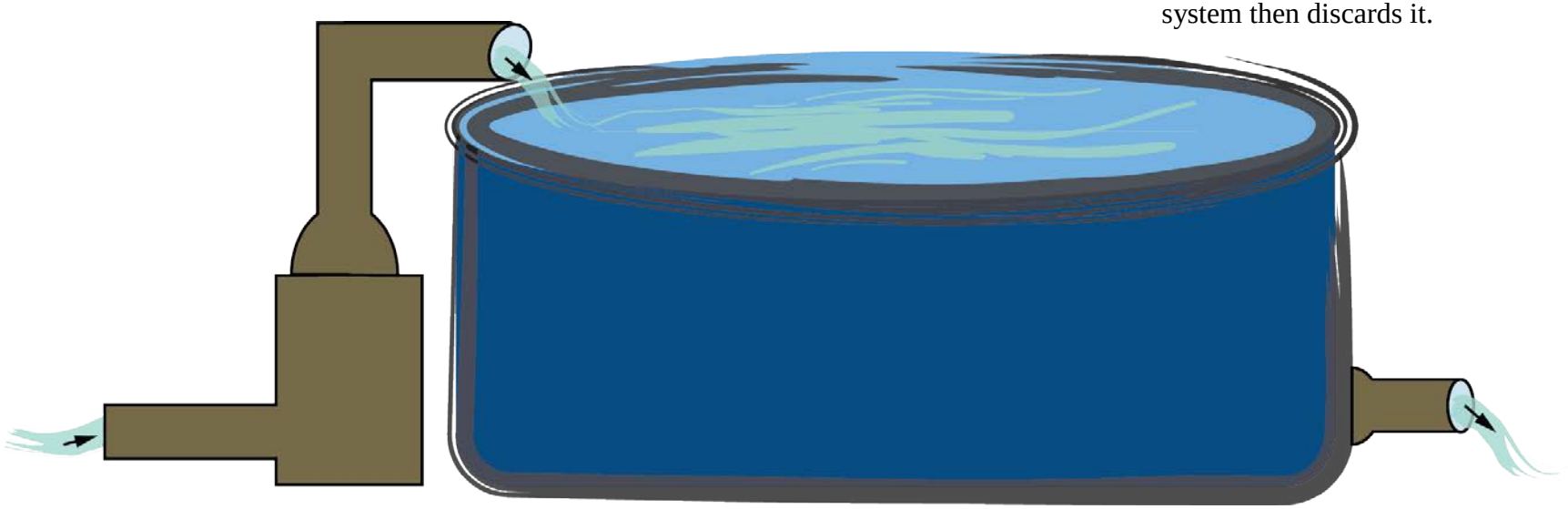


Figure 4a. Example of **recirculating** system, which recycles its water with the use mechanical and biological filtration.

Figure 4b. Example of **flow through** system, which passes water through a system then discards it.



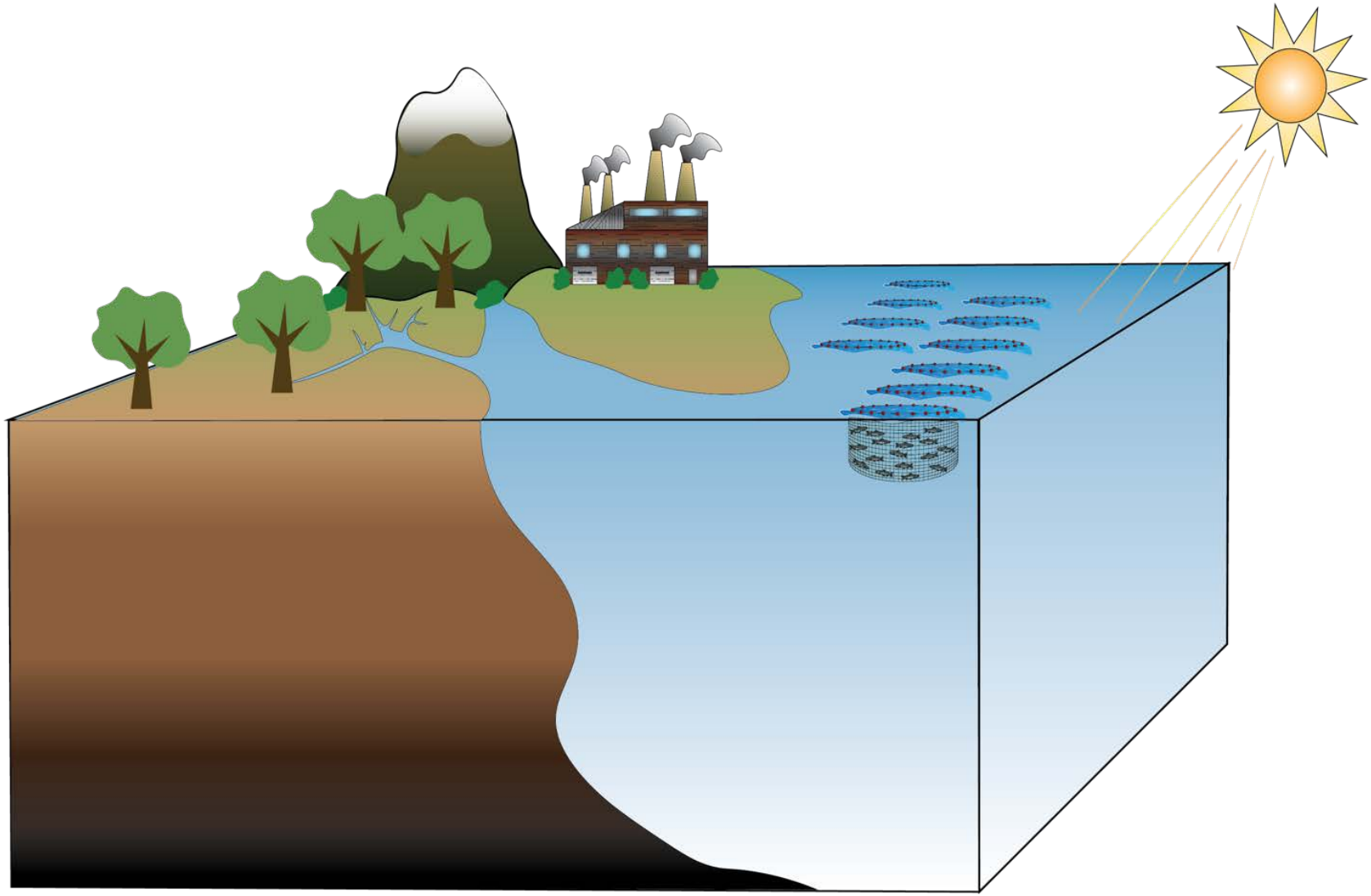


Figure 5. Example of **coastal aquaculture net pen** systems.

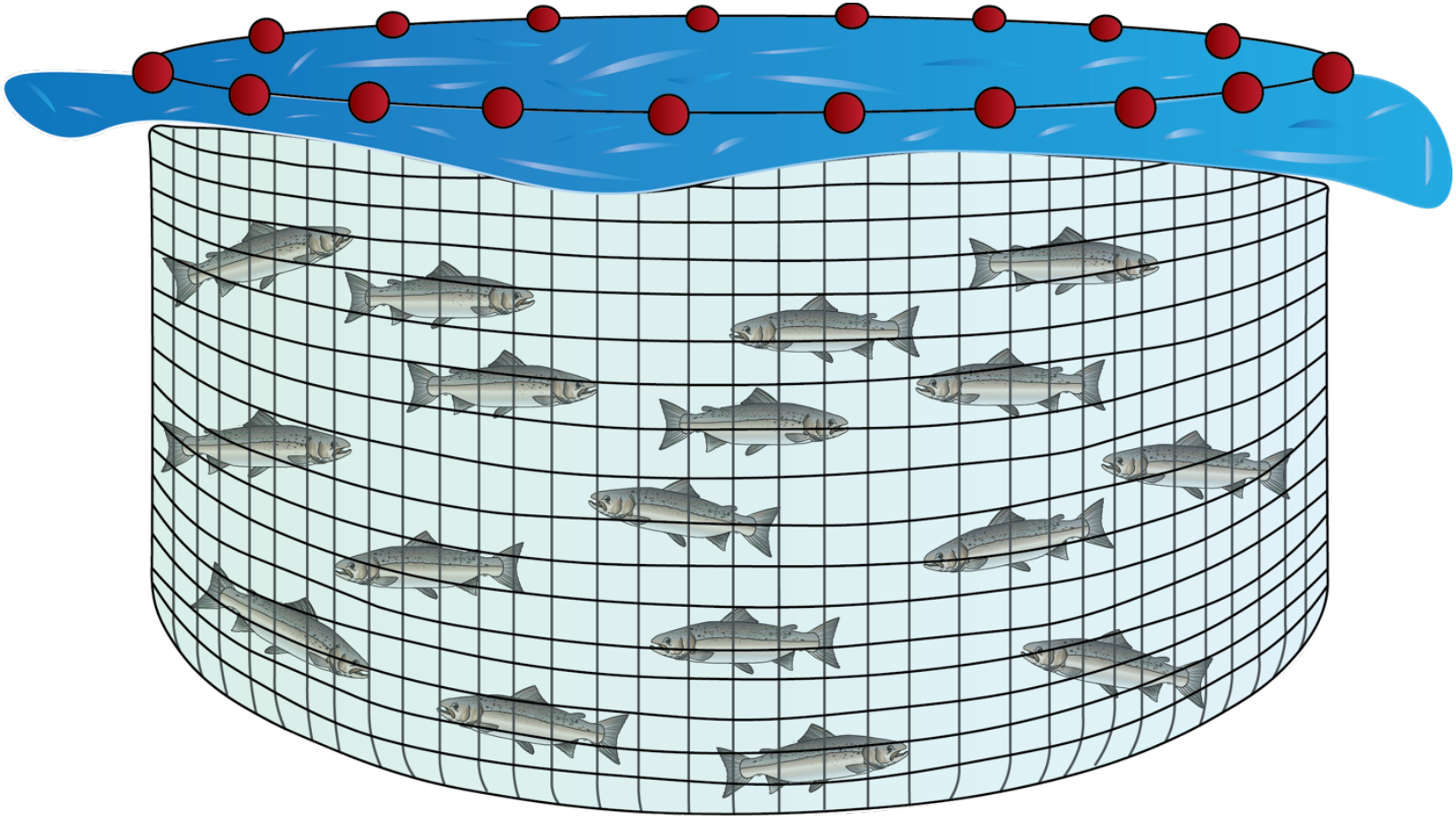


Figure 6. Close up view of **one type of net pen** system, where the fish are confined within a larger body of water. ***There are many different structures and models that can be used for coastal aquaculture operations.*** This is just one example of a common form.

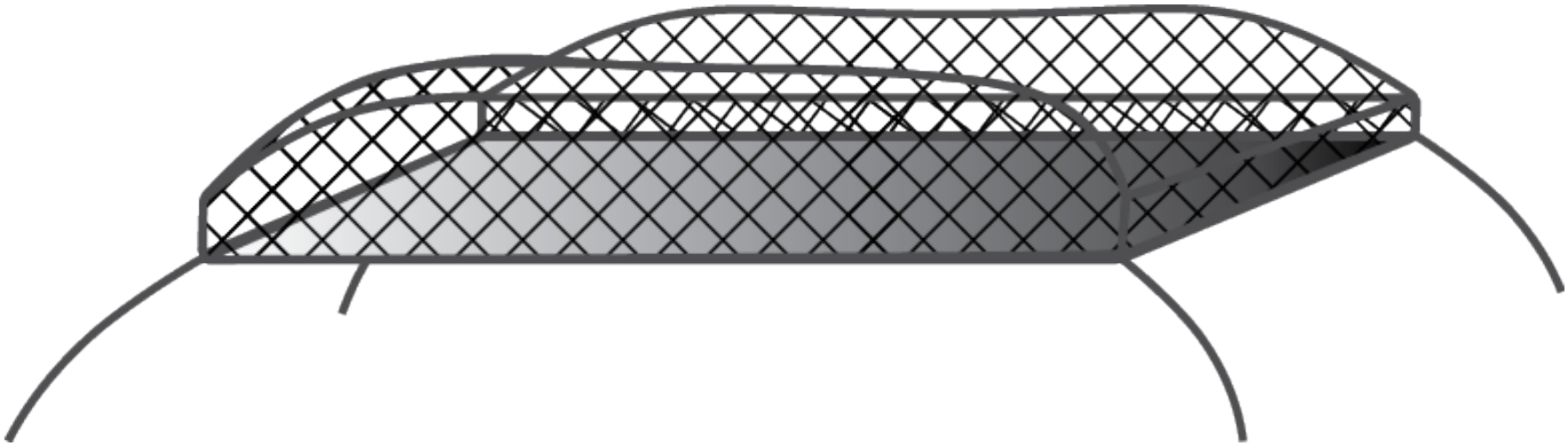


Figure 7. Illustration of a **tray culture**, this is used for bottom culture of shellfish.

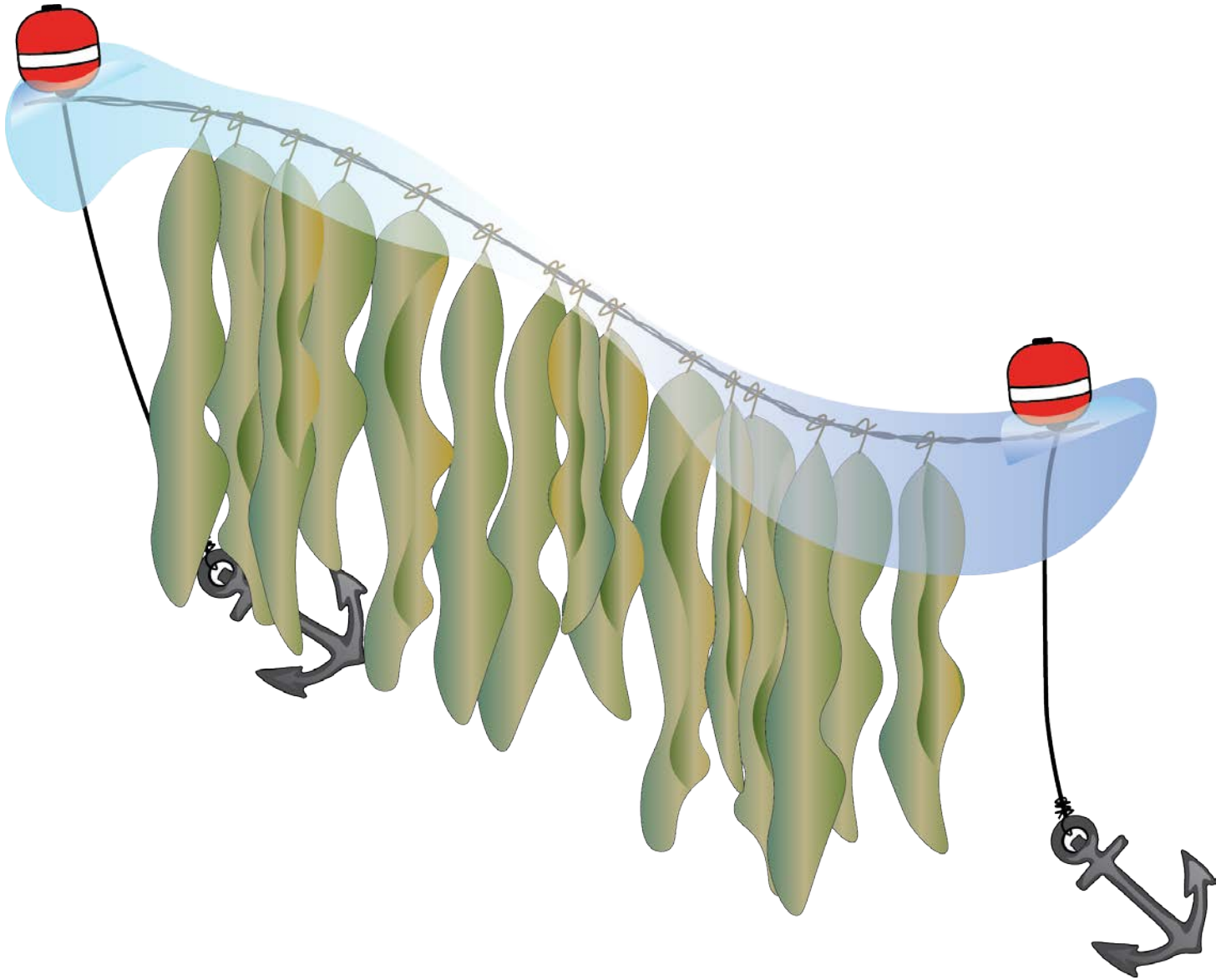


Figure 8. Example of the **top or floating culture of seaweeds**.

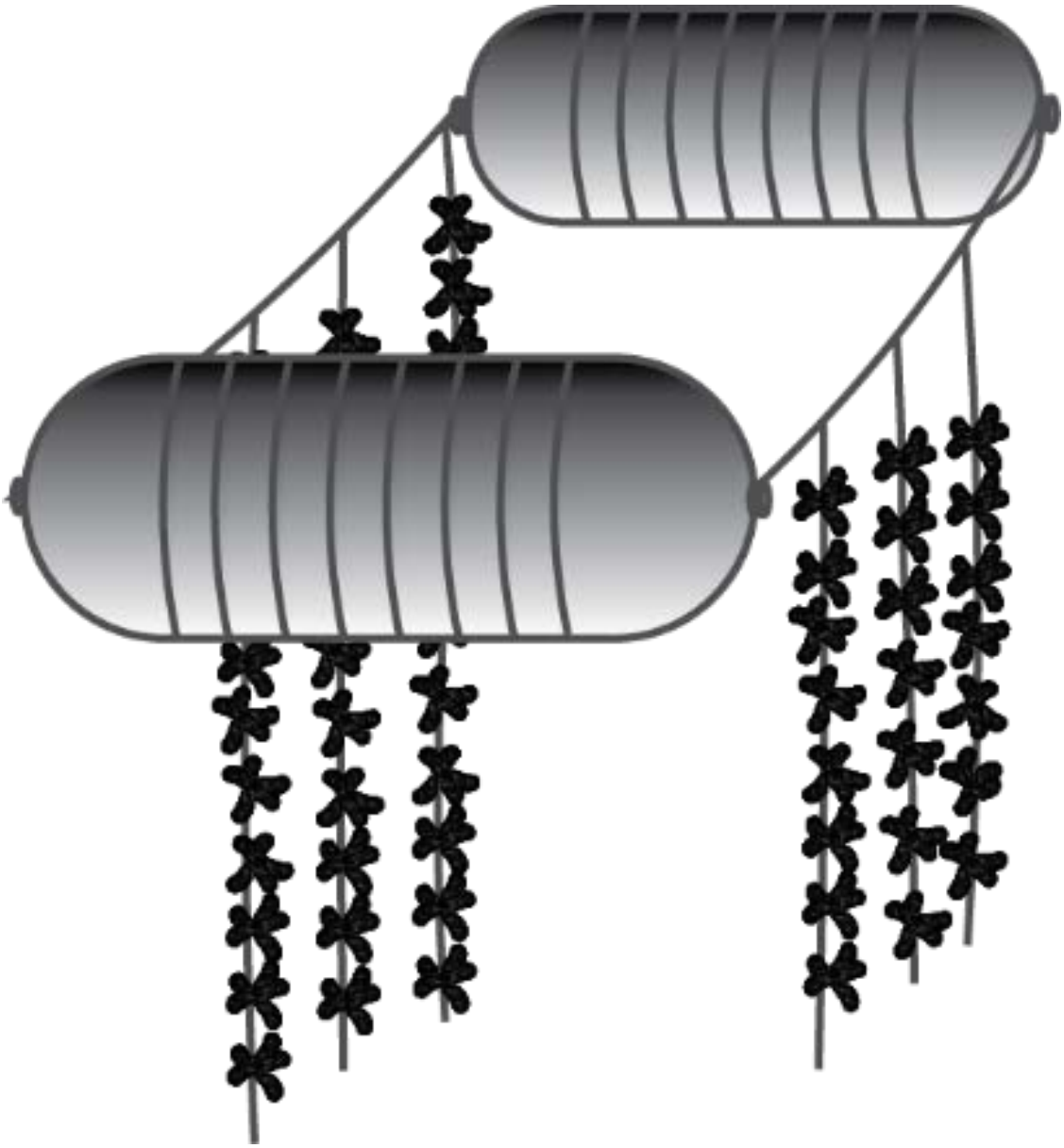


Figure 8. Example of a type of **top or floating culture of shellfish**.