

Sustainable Fishing

GRADE LEVELS	4 th -8 th grade; appropriate for 4 th grade - adult
SUBJECTS	Life Science, Constructing Explanations & Designing Solutions, Sustainability
DURATION	Preparation: 15 minutes Activity: 20-45 minutes
SETTING	Classroom

Summary

By using a model for how fishing affect marine life populations students will construct explanations for one of the reasons why fish populations are declining. They will then work to design solutions for ways of making fisheries more sustainable for the animals and the people who depend on them.

Objectives

Students will be able to:

1. use a model to explore how fishing effects the ocean animal populations.
2. construct explanations and design solutions for impacts of fisheries on healthy oceans.
3. identify ways individuals can influence impacts of the fishing industry and food sources.

Materials

- one bag of popped, plain popcorn (amount depends on class size)
- one or two bags of oyster crackers (amount depends on class size)
- one or two bags of Goldfish crackers (amount depends on class size)
- small cups, 1 per student
- serving bowls, medium size (or dinner plates), 1 per group
- spoons, 1 per student
- spatulas, 1 per group
- tongs, or chopsticks 1 per group
- watch, for timing the activity
- handout *Fishing Log*, 1 per student

Teacher Prep

1. Collect fishing utensils
2. Print out fishing logs (2 per student)
3. Make two "oceans" for each group of 5- 7 students: Put 60 goldfish pieces, 40 oyster crackers, and 40 popcorns in each bowl to make the ocean.
4. Print out "Seafood Market" plates (1 set per group of 5-7 students)
5. Print out Seafood Watch Cards, or use the "Seafood Watch App" on [Apple](#) or [Android](#)
6. Optional: gather some menus from a local seafood restaurant, use the app to find one

Introduction

One-billion people in the world depend upon seafood for their primary source of protein (Marine Stewardship Council, 2015). Today we're going to use a model to examine how fishing industries, and their tools work to capture fish. For this first part of the activity, our guiding question is: How does fishing impact populations of animals in the ocean?

Part 1: How does fishing impact populations of animals in the ocean?

1. Explain the game rules:
 - a. Each student will be a "fisher" whose livelihood depends on catching fish.
 - b. The goal is to catch seafood that they can sell at the *Seafood Market*.
 - c. Goldfish are the target species that they can sell. Popcorn represents other fish. Oyster crackers represent sea turtles.
 - d. Each fisher must catch at least five of the target fish (goldfish) in each round to survive to the next fishing season. There will be at least four fishing seasons total.
 - e. When the fishing begins, students will use a "net" (spoon) to catch their "fish" (crackers, popcorn, goldfish) from the "ocean" (bowl) and deposit them into their "boat" (cup).
 - f. If unwanted "animals" end up in their net, students cannot put any unwanted "bycatch" back into the "ocean".
 - g. The ocean animals remaining in the ocean after each fishing season represent the reproductive population, and thus one new cracker/popcorn/goldfish will be added for every ocean animal left in the ocean (bowl).
2. Divide the class into groups of five to seven students and have each group choose an ocean in which to fish such as Atlantic, Arctic, Southern, Pacific or Indian Ocean.
3. Give each group one bowl of fish, and each student one cup, one spoon, and one copy of the handout *Fishing Log*.
4. Put 60 goldfish pieces, 40 oyster crackers, and 40 popcorns in each group's bowl. These represent the ocean life. **Target fish catch** (goldfish in their cup), **other fish catch** (popcorn), and **bycatch** (such as sea turtles, represented by oyster crackers)
5. Remind students only to use spoons and not to collect with their fingers.
6. Students have to wait until the teacher says "start fishing!" Give the students 20 seconds for the first "season" of fishing.

Note: *If students are not depleting their oceans increase the "season" to 30 seconds.*
7. Have each fisher count his or her **target fish catch** (goldfish in their cup), **other fish catch** (popcorn), and **bycatch** (such as sea turtles, represented by oyster crackers) and record the data in their *Fishing Log*.
8. In order to survive to the next fishing season, fishers must catch at least five of the target fishery (goldfish). Fishers who did not catch the minimum must sit out for the following round or "fishing season".
9. Add one of each for every food item left in the bowl (ocean), explaining that the organisms reproduced themselves in between the seasons.

10. Allow one fisher per group to use the spatula during the second season to represent “trawling.” Record catches on the *Fishing Log*.
 - a. Repeat for season three, but have someone else use the spatula in the group.
 - b. In the fourth season, students use the spoons again plus one student per group uses a set of tongs or chopsticks (represents a hook and line).
11. What happened when an ocean ran out of fish? How are the fishers going to survive now? (One option is to move to another ocean.) Allow students to “invade” other ocean groups when their ocean is depleted, but don’t tell them that they can do this beforehand. Fishers may either go as a group to another ocean or they may disperse separately to other oceans.
12. Repeat fishing, recording, and replenishing fish stocks until all (or most) groups fish out their ocean.
13. Conduct a discussion about what happened to their fish. Have students use evidence from their fishing logs to talk about what happened over time.
 - a. Which fishing methods caught the most fish?
 - b. Which fishing methods collected unintended animals?
 - c. Are there other effects from fishing that are not represented in this model?

Part 2: How can fishing industries be changed so that they are sustainable?

1. Once the students have reflected on their first rounds of fishing, share with them that unfortunately, over 85% of the fish populations that people depend upon are no longer able to produce as much fish as they once were due to overfishing. This is a big problem because without healthy fish populations over 1-billion people won’t have enough food to survive.
2. Let the students know that people around the world are struggling with this issue, and that they are looking for different sustainable solutions. Have each group of students brainstorm ways that they might make the fisheries more successful in terms of allowing fishers enough catch so that they can survive, while also allowing enough fish to stay in the ocean and maintain healthy populations that can continue to reproduce over generations to come. Have each group write out their plans.
3. Put out fresh “oceans.” Have students try out their ideas, and compare advantages to each of them. Because students know how to play, this will go faster. Have students compare to the trend seen in the previous seasons.
 - a. What ideas were successful in keeping fish populations healthy over time?
 - b. Were there certain strategies that were helpful in minimizing bycatch?
 - c. Are there other considerations that came up that are important to address?

Part 3: Responsible Consumerism at the Seafood Market

After students have had a chance to explore what might make fishing industries more efficient, let them know that people who don't work in fisheries can also make an impact in making fisheries more sustainable. This is called **Responsible Consumerism**.

1. Students can then visit the *California Seafood Market* and become the "consumer" where they get a chance to see whether their favorite seafood is ocean-friendly or sustainably caught.

Note: If you are not in California, Seafood Watch, may have watch cards for your region. Check out the website to see if they do. If they don't this can still be used as an example of how some communities are trying to make a change.

2. Ask students, "What's your choice of seafood for dinner tonight?" Once students have made their decisions, they can flip their fish plate over to reveal whether they have made an ocean friendly, sustainable choice.
3. Have the students read the back of their plates to read more information as to why or why not their choice is sustainable. The back of the plates are titled: Best Choice, Alternative, and Avoid.
4. Once all the students have had a turn to examine the fish, provide them with Seafood Watch cards and allow them to practice using it as a guide when selecting their dinner choice. If you can get menus from local seafood restaurants, students can also practice with those. Additionally, you can use the Seafood Watch App to look for a fish friendly place.

Wrap-Up

At the end of the activities, have students reflect on the activities. What was the problem that they were trying to solve? What did it take to be able to make a change in the ecosystem? How might people in the real world react to these ideas?

Extensions

- Follow this activity with students examining the state of fisheries and fishing regulations close to home. Are there any animals that are being threatened by overfishing?
- Write letters of support, or thank yous, to Marine Sanctuaries, and businesses that support sustainable fishing. Conversely they can also write letters to businesses to let them know how to be more sustainable. Use the "Create a Campaign" lesson, or "Convince Me" as a guide:
www.calacademy.org/educators/lesson-plans/create-a-campaign
www.calacademy.org/educators/lesson-plans/convince-me

Scientific Terms for Students

- ❖ **bycatch:** Any fish or other organism that is unintentionally caught.
 - **ghost fishing:** when fishing gear is lost or abandoned at sea it can continue to catch fish, dolphins, whales, turtles, and other creatures as it drifts through the water and after it becomes snagged on the seabed.

- ❖ **extinction:** When the last individual of a particular species dies. There can be local extinction where a species ceases to exist in a certain ecosystem, or global extinction, which means it no longer exists in the world.
- ❖ **sustainable:** meets the needs of the present without compromising the ability of future generations to meet their own needs
- ❖ **responsible consumerism:** efforts by customers to make intentional purchase of both products and services that have minimal to no-impact harm to, or exploitation of humans, animals, or the environment. An example is the “Seafood Watch” program.

Background for Educators

Our oceans are increasingly affected by human activities, one of which is by the ways we catch seafood. This activity focuses on the threat of fishing, and some possible solutions for that specific issue.

Nearly 85% of the world's fisheries are fished to capacity or overfished. This means that wildlife populations in the ocean, from fish to turtles to seabirds, are put at risk. It also means that the people who depend on the fisheries for their own survival are at risk.

Seafood products from California to the Philippines and beyond are threatened when high levels of consumption and highly destructive fishing activities put a high pressure on fish populations and habitat. Healthy populations are not only important for food consumption, but also for maintaining equilibrium of the food web, and ultimately the whole ecosystem. Additionally, in areas where there are coral reefs and low lying land, the healthy systems provide another important service: storm protection.

Our seafood choices have the power to make this situation worse or improve it. Some of the criteria for knowing whether or not seafood is sustainable is understanding the following:

- Is the species in trouble in the wild where the animals were caught?
- Does fishing for the species damage ocean habitats?
- Is there a large amount of bycatch taken with the target species?
- Does the fishery have a problem with discards—generally, undersized animals caught and thrown away because their market value is low?

The first part of the activity focuses on helping learners understand more about fishing practices and bycatch. The second part of the activity highlights the Seafood Watch Program, which works with scientists, fishers, and communities to rate fish based on the criteria above, and make recommendations on which seafood to eat, or avoid. This is called **responsible consumerism**.

Fishing Methods

Some fishing methods, such as purse seining and dredging, catch a significant amount of **bycatch** because they use nets in the water column, which sometimes capture unintended animals.

Additionally, some methods, such as trawling, cyanide fishing and explosives also wreak havoc on the seafloor, uprooting long standing corals and kelp beds.

More environmentally friendly methods include trolling, a hook-and-line method that tows fishing lines behind or alongside a boat. Fishermen use a various baits to "troll" for specific fish at different depths. This method catches fish that will follow a moving lure or bait, such as salmon, mahi mahi and albacore tuna. Trolling is an environmentally responsible fishing method. Fishermen can quickly release unwanted catch from their hooks since lines are reeled in soon after a fish takes the bait.

Conservation & Sustainability Methods

There are many potential solutions regulating fisheries so that they are more **sustainable**, which means that it meets the needs of the present without compromising the ability of future generations to meet their own needs. Students will be asked to come up with their ideas for ways to be more sustainable. This will help them build critical thinking skills. However, if they struggle, you can introduce some of these ideas.

- **Catch Limits:** the maximum number of fish that an angler may catch from a specified waterbody or a portion of a waterbody in one day.
- **Catch Share:** a fishery management system that allocates a secure privilege to harvest a specific percentage of a fishery's total catch to individuals, communities and/or associations throughout the season. This often creates an increase in fish available over time.
- **Marine Sanctuary:** is a federally designated area within United States waters that protects areas of the marine environment with special conservation, recreational, ecological, historical, cultural, archeological, scientific, educational, or aesthetic qualities.
- **Outlawing certain fishing methods:** Many places are now outlawing trawling, explosives, and cyanide fishing in order to prevent bycatch, and environmental problems.
- **Responsible Consumerism:** If people refuse to buy certain fish because there is too much impact on the animal populations then they are practicing "responsible consumerism." Sometimes this means buying "good alternatives," or choosing not to consume fish at all.

References

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Correlated California Content Standards

Grade Three

Life Sciences

3c. Students know living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.

3d. Students know when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.

Investigation and Experimentation

5c. Use numerical data in describing and comparing objects, events, and measurements.

Grade Four

Life Sciences

2b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.

Grade Six

Earth Sciences

6b. Students know different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests, and know how to classify them as renewable or nonrenewable.

Grade Seven

Life Sciences

3e. Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

Next Generation Science Standards

The items listed below indicate how the Sustainable Fishing Activities supports the three dimensions of the Next Generation Science Standards (www.nextgenscience.org).

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>Developing and using models</p> <p>3-5: Develop a model using an example to describe a scientific principle.</p> <p>Constructing Explanations and Designing Solutions</p> <p>3-5: Use evidence to construct or support an explanation or design a solution to a problem.</p> <p>3-5: Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.</p>	<p>ESS3.C: Human Impacts on Earth Systems</p> <p>Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.</p>	<p>Cause and Effect</p> <p>3-5: Cause and effect relationships are routinely identified, tested, and used to explain change.</p>

Related Performance Expectations

Remember, performance expectations are not a set of instructional or assessment tasks. They are statements of what students should be able to do after instruction. This activity or unit is just one of many that could help prepare your students to perform the following hypothetical tasks that demonstrate their understanding:

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. www.nextgenscience.org/5ess3-earth-human-activity

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact.] <http://www.nextgenscience.org/msess3-earth-human-activity>