



How to Catch a Fish

Students conduct an experiment that demonstrates the effects of different fishing methods on bycatch. They use this foundation to create posters and public service announcements to share this information with other students.

SUBJECTS

Science, social studies,
language arts

GRADE LEVEL

Grades 5–8

TIME

30 minutes for the experiment
1-2 hours for research and poster/
PSA development

OBJECTIVES

Students will be able to

- name advantages and disadvantages of four different fishing methods.
- define "bycatch."
- identify some of the impacts of bycatch on ocean ecosystems.

BACKGROUND

Due to advances in technology, commercial fishermen have significantly improved their ability to catch fish, navigate ocean waters and travel greater distances, and some can now process and freeze their catch onboard.

Scientific research has shown that new technologies are enabling exploitation of fish at unsustainable levels. What does this really mean? With more effective catch technology, there are too many boats fishing too few fish. Fish are being taken at a rate that is faster than the reproductive capabilities of the fish populations—thus the populations are unsustainable.

Increasing demand and decreasing supply leads to serious problems: environmental degradation, unsustainable catches, and economic hardship for a growing number of individuals and large sectors of the fishing industry. Environmental problems include overfishing on a global scale, habitat destruction and bycatch.

This lesson focuses on understanding the environmental impacts of overfishing, fishing gear, habitat destruction and bycatch.

TEACHER PREPARATION

For each student group, prepare a paper cup that contains a mixture of individual foods (*sprinkles, small pasta, large pasta, Goldfish Crackers*). The foods will represent different marine organisms. Each cup can have different ratios of the contents, but they all should be somewhat similar (*that is, one cup can have five "sharks" and another 10, but one cup should not have just one shark while another has 20*).

MATERIALS

- Fishing Technologies and Gear student handout
- A Net Loss: The Effects of Bycatch student handout
- One bag of sprinkles
- One small bag of small elbow pasta
- One small bag of large elbow or ziti pasta
- One bag of Goldfish Crackers
- One "net" per group, various sizes of netting or colanders
- One large paper plate and one cup per group
- Poster board
- Markers
- Fishing Gear and Technology Sample Chart teacher sheet

STANDARDS

National Science Education Standards Grades 5–8

<http://222.nap.edu/catalog/4962.html>

Science in Personal and Social Perspectives – Content Standard F:

Populations, resources and environments

PROCEDURE

- 1. Check existing knowledge:** Ask your students to name as many types of fishing methods as they can think of. Do they know what is good or bad about each of the methods they name?
- 2. Introduce fishing methods:** Using the Fishing Technologies and Gear handout, introduce students to the different methods of fishing, from artisanal diving and spearfishing to longlining and trawling. Discuss the positives and negatives of each method, from the perspectives of both the fish and the fisher. Create a class chart listing the advantages and disadvantages of each method from each perspective (*see teacher page for sample format*).
- 3. Introduce bycatch:** Distribute the handout A Net Loss: The Effects of Bycatch and ask students to read it.
- 4. Divide students into groups and distribute supplies:** Divide the students into groups and conduct the following experiment to demonstrate the issues surrounding bycatch:
 - Provide each group with a "net" and a paper cup filled with a mixture of the different foods. Tell them which food represents which organism or species:
 - Sprinkles = zooplankton
 - Small pasta = juveniles of targeted fish species
 - Large pasta = adults of targeted fish species (these are the targeted catch)
 - Goldfish Crackers = sharks
 - Ask each group to dump their cup into their net and to sift the contents. Then have each group count and document the species that remain in their net after sifting.
 - Select two groups to report only their catch of the targeted species (large pasta) and not their bycatch. This will demonstrate the difficulties of creating statistics from inconsistent reports.

Science and technology in society

**Ocean Literacy:
Essential Principles and
Fundamental Concepts**
[http://coexploration.org/
oceanliteracy/](http://coexploration.org/oceanliteracy/)

**Essential Principle #6:
The oceans and humans are
inextricably interconnected.**

- b. From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.
- 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 activity lead to pollution (point source, nonpoint source and noise pollution) and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the oceans.
- 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. Individual and collective actions are needed to effectively manage ocean resources for all.

- d. Ask each group to report their catch to the National Marine Fisheries Service by writing their results on the blackboard. They should keep their report simple:

Catch	Number
Sharks	5
Juvenile fish	8
Adult fish	29
Zooplankton	2
Total desired catch (adult fish)	29
Total bycatch	15
Total catch	44

5. **Compare statistics:** Find the average total catch and the average target catch of *all* groups. Find the average of *only* those groups who reported their correct catch data and compare with the results from all groups.
6. **Discussion:** Use the results to discuss the following questions:
 - What did they learn from the exercise?
 - What do the results mean for those people who rely on catch reports to make management decisions?
 - How can we account for bycatch?
For inaccurate catch data?
 - How can we avoid inaccurate catch data?
 - How can fish catch reports be improved?
7. **Educate others about bycatch species:** Have each group select a species that is nontarget, or bycatch (*e.g., sharks, dolphins, turtles, albatross, etc.*), and design a poster or public service announcement (radio, television, print) to educate other students in their school about bycatch issues. Each group should use illustrations and statistics to demonstrate the extent of the problem. (*Note: Encourage groups to select different species as the subject of their poster or public service announcement. Be sure at least one group selects sharks.*)
8. **Reflection:** Discuss these questions.
 - Why is it important for us all to understand the limits to our ocean's resources?
 - How will bycatch impact the environment and our economy in the future?

EXTENSION

- Students can select a specific fishery and complete an in-depth case study, examining the following:
 - Fishing methods
 - Fishery locations
 - Supply and demand
 - Bycatch issues or other related environmental concerns
 - State and federal regulations surrounding this fishery
- Students can write a report on the current state of that fishery.

FURTHER RESOURCES

Additional educator resources for **Jean-Michel Cousteau Ocean Adventures** can be found at pbs.org/oceanadventures.

Also try:

- Monterey Bay Aquarium's Fisheries in Trouble page
http://www.mbayaq.org/cr/cr_seafoodwatch/sfw_issues.asp
- National Marine Fisheries Service Commercial Fisheries
<http://www.nmfs.noaa.gov>
- Pinnipeds and Fishing Gear
<http://www.imma.org/pinniped.html>

CREDITS

Adapted with permission from *Fish Trouble: A Teachers Guide*. For more information, contact The University of Miami Rosenstiel School of Marine and Atmospheric Science, K-12 Science Education, 4600 Rickenbacker Causeway, Miami, FL 33149, (305)421-4937, ambient@rsmas.miami.edu. Similar publications can be downloaded at <http://www.rsmas.miami.edu/groups/niehs/ambient/>

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Fishing Gear and Technology - Advantages and Disadvantages

SAMPLE CHART

FISHING METHOD	FROM THE PERSPECTIVE OF THE FISH		FROM THE PERSPECTIVE OF THE FISHER	
	Advantages	Disadvantages	Advantages	Disadvantages
Gillnets				
Longlines				
Bottom Trawls				
Midwater Trawls				
Traps (Pots)				
Purse Seines				
Hookas				
Spearguns				
Hook and Line				

Fishing Gear and Technology - Advantages and Disadvantages

Gillnets

Kept at the desired depth by floats or weights, these long nets trap and entangle fish, turtles and marine mammals as the lines move with the current or the boat to which they are attached.

Longlines

These lines with baited hooks are kept at the desired depth by spaced floats (for drift longlines) or held to the bottom with weights (*bottom longlines*).

Bottom Trawls

Bag-shaped nets are held open at one end by long horizontal beams, or planers, and dragged along the ocean bottom to catch fish and shrimp.

Midwater Trawls

Large bag-shaped nets, open at one end, are towed by a boat to catch fish between the surface and the bottom.

Traps (Pots)

These are cages and baskets made of wood, wicker, metal rods, wire netting or other materials for catching fish and crustaceans that enter through one or more openings. The traps are set at the bottom and connected to ropes attached to buoys on the surface.

Purse Seines

Large nets surround fish and are drawn closed at the bottom, like a purse, preventing fish from diving to escape.

Hookas

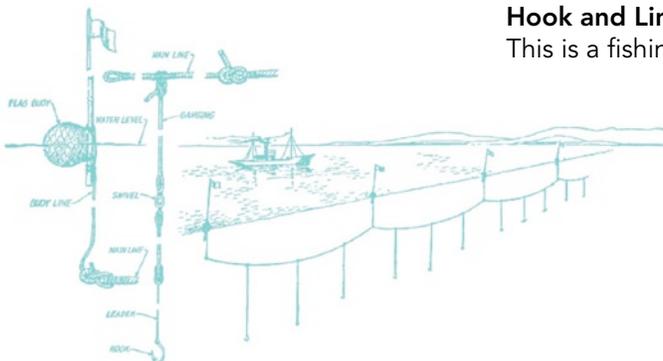
Using hoses and compressors, divers use this method to collect such species as lobster and sea cucumbers from the ocean floor.

Spearguns

These are guns whose ammunition is spears rather than bullets. They are used to shoot fish one at a time. Generally, they are used only by recreational fishers and by small-scale artisanal fishers. Spearguns can be used in conjunction with the hooka method.

Hook and Line

This is a fishing rod with one line and one hook.



A Net Loss: The Effects of Bycatch



What is bycatch?

Commercial fishing boats generally intend to target only a few commercially valuable species, but the gear and fishing technologies they use often catch much more than just these specific marine animals. More than 25 percent of all species caught are not used. These unwanted animals are dumped back into the ocean, dead or dying.

What species are affected and how?

As bycatch, marine animals become waste. Marine mammals, including dolphins, whales, seals and sea lions, as well as sharks and sea turtles fall victim when entangled in nets intended for tuna, pollock, cod and other fish. Baited hooks from longlines, splayed out for miles behind boats, attract seabirds, such as albatrosses and petrels, which often get hooked and dragged underwater, where they drown. Shrimp trawling is especially devastating when it comes to bycatch. For every pound of wild shrimp caught, an average of eight pounds of bycatch is discarded. Juveniles of many commercially fished species are routinely caught and discarded as bycatch, destroying their future reproduction potential. Some bycatch species are valuable food sources; nevertheless, if they are not the target species, they become waste. Boats seeking halibut discard cod as bycatch, and boats seeking cod discard halibut.

A Net Loss: The Effects of Bycatch (continued)

What does this mean for our oceans?

Approximately 60 million tons of marine life are killed and wasted each year as bycatch. Even though these species may not be valued as food, they play an important role in the ocean ecosystem and its food webs. We're taking away a source of food for many forms of marine life, from sharks to swordfish. Some marine populations face a significant threat from these practices. Of the seven marine sea turtle species, six are endangered and one is threatened. All fall victim to bycatch.

Are there alternatives?

Technology can be used to improve fishing techniques to decrease bycatch. To stop sea turtles from drowning in shrimp trawl nets, a system called the Turtle Excluder Device, or TED, was developed. The TED is a grid of bars at the top of the nets that allows shrimp to slip through and at the same time keeps larger animals like turtles from entering. This method helps prevent much of the sea turtle bycatch in the shrimp fishery without affecting shrimp catches. However, TEDs are not required worldwide, and sea turtle bycatch continues where they are not in use. Trawlers can use similar fish excluder devices, but again, the use of this technology is not required or enforced on a global scale.

Scientists and fishers have also developed methods to protect seabirds from getting caught on the hooks of longlines. Some lines are now equipped with streamers and other devices to scare away birds or with weights that cause the hooks to immediately sink below the surface. These methods can help to significantly reduce the mortality of seabirds as bycatch on longlines.

Probably the most well-known attempt to reduce bycatch is "dolphin-safe" tuna. Today, all tuna caught in the United States must be caught with minimal threat and harm to dolphins. Unfortunately, the practice of encircling dolphins in nets to find tuna, which results in the entanglement and drowning of dolphins, is still practiced in other parts of the world.