

# DROP IN THE OCEAN

## introduction

The oceans cover the majority of the planet and affect and sustain all life on Earth. Human-driven activities significantly influence the oceans. Increased pollution, depletion of fish and other marine resources, habitat destruction and degradation, and the introduction of invasive species are only some of the ways people harm the ocean, and all have serious consequences for the entire planet. As our global population has grown seven-fold in past 200 years, our demand on ocean resources has grown significantly and our harmful impacts on ocean ecosystems have accelerated.

**Vocabulary:** algal bloom, bottom trawling, bycatch, ecosystems, fish kill, overfishing, photic zone, phytoplankton, red tide, sustainable yield, upwelling

## materials

### Part 1

- Apple
- Knife
- Cutting board
- Non-food alternative to apple and knife: Ball of Play-Doh and dental floss

### Part 2

- Assignment Sheet (provided)
- Poster board or access to PowerPoint

## Part 1: The Photic Zone

This activity explores the food supply from our oceans and is adapted from the activity, “Earth: The Apple of Our Eye,” which explores the land area available to grow food.

## procedure

Slice the apple according to the instructions, narrating as you go, and then go through the Discussion Questions as a class. For a non-food option, use a baseball-size ball of Play-Doh. The Play-Doh will need to be firm so it keeps shape while you cut it with the dental floss.



Studies For Our Global Future

### concept

Our growing population depends on the oceans for food resources. Though the oceans are vast, the productive zones are limited and many have been overfished.

### objectives

Students will be able to:

- Identify what fraction of the ocean is capable of supporting marine life and providing food for the human population.
- Discuss threats to the ocean’s ability to provide food and ways it can be protected.
- Conduct research and create a poster or PowerPoint presentation on an overfished species.

### subjects

Environmental Science (General and AP), AP Human Geography, Geography, English Language Arts

### skills

Observing, understanding cause and effect, researching, visually communicating research

### method

A visual demonstration models the limited ocean area where most ocean life is found, followed by a discussion and research project exploring how human’s food supply from the ocean can be managed more sustainably.

Apple	Earth	Narrative
Whole Apple	Planet Earth	Hold the apple out so the class can see it. <i>"This apple represents our planet."</i>
1/4	Land	Cut the apple into quarters. Hold out 3/4 in one hand. Ask the class, "What do these 3/4 represent?" (Water) Hold out the remaining quarter and acknowledge that it represents Earth's land areas. Set it aside.
3/4	Water	Return to the 3/4 of the original apple that represents water. <i>"Some of our food comes from the sea. Approximately 3 billion people in the world rely on both wild-caught and farmed seafood as their primary source of protein.<sup>1</sup> Yet, despite their vastness and seeming uniformity, many regions of the world's oceans are unproductive due to a lack of life-supporting nutrients."</i>
1/8	Food Productive Areas	Slice one of the three water pieces in half, lengthwise. Set the remaining 1/4 and 1/8 pieces representing water aside, leaving just 1/8 of the total apple. Hold out the remaining 1/8 slice. Ask the class, "What fraction of the whole apple is this?" (1/8) "What fraction of the water is this?" (1/6) <i>"This piece represents the ocean's productive zones along the equator and the western margins of continents. Currents in these areas cause <b>upwelling</b>, a process where deep, cold water comes to the surface and brings nutrients along to the surface as well. These nutrients support large numbers of marine plants and animals."</i>
1/32	Photic Zone	Cut the 1/8 productive zone piece into four equal pieces cross-wise. Hold up one piece and ask students, "What fraction of the Earth is this?" (1/32) "What fraction of the water is this?" (1/24) Carefully peel the apple's skin from the one piece. Hold out the peel. <i>"This peel represents the <b>photic zone</b>, the top 100 meters (330 feet) of the ocean which light can penetrate, supporting photosynthesis. Since the marine food chain depends on algae and photosynthesizing plants, especially <b>phytoplankton</b>, almost all ocean life depends on this narrow photic zone. At 100 meters below the surface, the amount of light is only 1 percent of what it is at the surface."<sup>2</sup></i>

## discussion questions

1. Did it surprise you that only  $\frac{1}{24}$  (less than 4 percent) of the Earth's vast oceans are in the photic zone that supports the marine food chain? Do you think the apple cutting is an effective model for illustrating this point? Why or why not?

Answers will vary.

2. How do you think population growth impacts the ocean's ability to produce food for humans?

*As the human population grows, so does the demand for fish and shellfish, which is a major source of protein for people around the world. The ocean can't produce an ever-increasing amount of seafood. There is an upper limit to the amount of fishing that can maintain a **sustainable yield**.*

3. What human activities jeopardize the ocean's health and capacity to produce food for humans?

*Two major factors are water pollution and unsustainable fishing practices/overfishing. To provide students with more context, have them read the Earth Matters reading "Oceans of Problems for the Blue Planet," or share with them some of the following information.*

- **Water Pollution:** Fish and shellfish use estuaries (water passages where rivers and tidal currents merge, usually in shallow waters near shores) as spawning grounds. But rising levels of water pollution and destruction of coastal ecosystems make it increasingly difficult for sea life to find healthy spaces in which they can successfully reproduce. Nutrient pollution (such as excess nitrogen and phosphorus) is widespread in U.S. estuaries, affecting two-thirds of estuarine areas and causing harmful **algal blooms, red tides, and fish kills**.<sup>3</sup>

*About 37 percent of the world's population lives within 100 kilometers, or 62 miles, of the ocean or sea.<sup>4</sup> In the United States in 2018, 128 million people, nearly 40 percent of the nation's population, lived in counties directly on shoreline.<sup>5</sup> Much of the sewage, trash, industrial pollution, and agricultural run-off produced by these populations finds its way into nearby coastal waters. Inland communities also contribute to ocean contamination, as rivers carry the same pollutants from landlocked population centers out to sea.*

- **Overfishing:** Overfishing threatens our ability to maintain a sustainable yield of seafood into the future. When we take too many fish from the ocean, there are too few left to reproduce and restore their population. Between 1950 and 1995, the world's human population more than doubled and, in turn, the monitored annual world fish catch almost quadrupled. This was made possible by larger ships with more powerful engines, refrigeration that allowed vessels to catch and store more fish, and fishing technologies such as sonar and **bottom trawling**. About one-third of the world's fish stocks, especially at higher trophic levels, are classified as being fished at biologically unsustainable levels, and most of the rest of the fish stocks (60 percent) are fished out at maximally sustainable levels.<sup>6</sup>

*In addition, many of our fishing practices result in **bycatch** – marine life that was not targeted getting caught in fishing nets. Turtles, dolphins, whales, and other species may be hurt or killed by careless use of fishing lines and nets, which endanger their already precarious survival.*

4. How can we preserve the ocean's health and food-producing capability?

- By voluntarily restricting our consumption, especially of endangered seafood species, so fish stocks have a chance to regenerate.
- By reducing pollution in all forms. We each encounter many opportunities to do this in our daily lives. Placing trash in the proper receptacles keeps it from finding its way into waterways. Taking hazardous substances (such as used motor oil, antifreeze, and other household toxins) to disposal centers rather than emptying them into the sink, toilet, or storm drain keeps them out of the water supply and natural bodies of water. Maintaining our cars properly can prevent their leaking oil and other substances onto the roads, which would otherwise "run off" the pavement whenever it rains, into lakes, streams, rivers, and eventually, the ocean.
- Expand existing marine reserves and create new reserves to permanently protect vulnerable species.
- By stabilizing population growth. More people consume more resources and produce more garbage and other forms of pollution.

## Part 2: Too Many Fish Out of Water

### procedure

1. Distribute the Assignment Sheet, one per student, and go over the project with the class.
2. Discuss the different kinds of information sources the students should seek out during their research. Explain why information from some sources may carry a bias, and discuss how to identify that bias based on the source – industry groups, advocacy groups, or governmental groups.
3. Allow students time to complete their research and create their presentations.

### assessment

Evaluate the students' presentations, looking for depth of research, analysis of the multiple factors affecting the species' well-being, and clarity of presentation.

### follow-up activities

1. Students contact local grocery stores or restaurants and conduct a short interview with the appropriate person to find out the sources for the seafood they sell. Did this business consider sustainability when choosing a fish provider? Students should prepare 3-5 interview questions before conducting the call or in-person interview. After the interview have students compile their interview notes into a short transcript depicting what they found.
2. Designate three areas of the room as either: Agree, Unsure, or Disagree and then read the following statements aloud. After taking a moment to consider the statement, students move to the area that represents their views. Ask students to explain why they chose the location where they are and allow time for discussion. Students may feel compelled to change their stance after listening to their classmates. After the discussion, have students write a persuasive essay on the stance they took.
  - Protecting the ocean isn't that important because we will eventually find a way to clean up the existing pollution.
  - We should focus more on finding solutions to the ocean's current problems than preventing additional problems from happening.
  - Sustainable fishing only makes sense in parts of the world where people fish the most.

Part 1 based on "Apple Ocean," from: *Project O.C.E.A.N. Habitat Curriculum Guide (Draft)* by the Oceanic Society/San Francisco Bay Chapter, <https://www.oceanicsociety.org/>

<sup>1</sup> World Wildlife. (n.d.). *Sustainable Seafood Overview*. Retrieved October 18, 2021 from <https://www.worldwildlife.org/industries/sustainable-seafood>

<sup>2</sup> Oceanic Society. (1998). *Apple Ocean*. Project O.C.E.A.N. Habitat Curriculum Guide (Draft).

<sup>3</sup> United States Environmental Protection Agency. (n.d.). *National Coastal Condition Assessment 2015 Key Findings*. Retrieved from <https://www.epa.gov/national-aquatic-resource-surveys/national-coastal-condition-assessment-2015-key-findings>

<sup>4</sup> United Nations Environment Programme. (n.d.). *Coastal zone management*. Retrieved October 18, 2021 from <https://www.unep.org/explore-topics/oceans-seas/what-we-do/working-regional-seas/coastal-zone-management>

<sup>5</sup> National Oceanic and Atmospheric Administration. (2021, February). *What percentage of the American population lives near the coast?* Retrieved from <https://oceanservice.noaa.gov/facts/population.html>

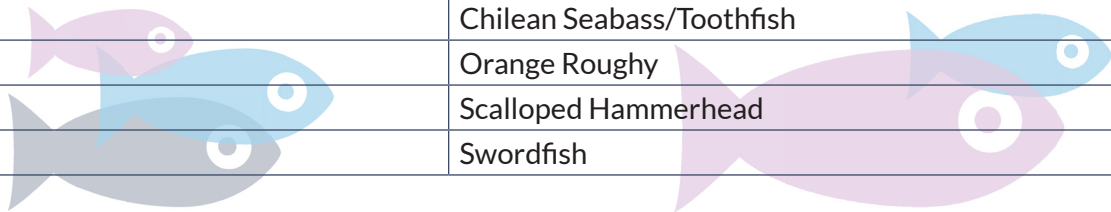
<sup>6,7</sup> Food and Agriculture Organization of the United Nations. (2020). *The State of World Fisheries and Aquaculture 2020*. Retrieved from <https://www.fao.org/state-of-fisheries-aquaculture>

# DROP IN THE OCEAN | assignment sheet

Around the world, fisheries are threatened with collapse due to unsustainable fishing methods and ecosystem destruction. Since 1950, commercial fishermen increased their catch by 500 percent to keep up with the growing demand for seafood. Since 1989, many fish populations have been caught faster than they can reproduce. Even so, new boats are set into the waters every year around the world.<sup>7</sup>

## EXAMPLES OF OVERFISHED SPECIES

Atlantic Cod	Chilean Seabass/Toothfish
Atlantic Salmon	Orange Roughy
Atlantic Halibut	Scalloped Hammerhead
Bluefin Tuna	Swordfish



Select an overfished species from the chart to research. Create a poster or electronic slide presentation (using PowerPoint, Google Slides, etc.) that answers the questions below. A photo of the fish should be included.

- What type of fish did you research?
- Where does it live?
- Who fishes it and how? Do they fish it to sell or as a source of food for themselves (subsistence fishing)?
- Where do most of the consumers of the fish live?
- How can people help increase the population of the fish?

You may want to start your research on the Monterey Bay Aquarium's Seafood Watch website (<https://www.seafoodwatch.org>).