NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 1 HR 40 MINS

Under the Sea

Students consider how various types of plastics could impact different marine organisms through two broad types of plastic impacts: entanglement and ingestion. Next, students examine plastic impacts across six trophic levels of organisms: producers, primary consumers, secondary consumers, tertiary consumers, apex predators, and decomposers. Finally, groups investigate different ecosystems to apply what they learned about specific impacts of plastics on a wider variety of marine organisms.

GRADES

6 - 8

SUBJECTS

Biology, Ecology, Conservation

CONTENTS

7 PDFs

OVERVIEW

Students consider how various types of plastics could impact different marine organisms through two broad types of plastic impacts: entanglement and ingestion. Next, students examine plastic impacts across six trophic levels of organisms: producers, primary consumers, secondary consumers, tertiary consumers, apex predators, and decomposers. Finally, groups investigate different ecosystems to apply what they learned about specific impacts of plastics on a wider variety of marine organisms.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/under-sea/

In collaboration with

educurious
learning that connects

DIRECTIONS

***Plastics: From Pollution to Solutions* unit driving question**: *How can humans solve our plastic problem in the ocean?*

***Plastic in the Plankton, Plastic on Your Plate* lesson driving question**: *How do plastics affect ocean organisms and ecosystems?*

1. Introduce students to the diversity of marine organisms.

- Display the image of diverse marine organisms as silhouettes.
- Ask: *Which of these organisms can you identify?*
    - Possible responses: dolphins, sharks, swordfish, rays/skates, starfish, turtles, eels, snakes, seahorse, lionfish, crabs, jellyfish, octopus, clams, whelks, anemones, coral, seagrass, kelp
- Explain that life in the oceans is much more than just fish. In fact, much of the life in the oceans is microscopic. Marine microorganisms tend to fall in two broad categories:
    - Phytoplankton, including many types of algae, make their own food from sunlight and produce as much oxygen as land plants.
    - Zooplankton, including krill and many types of fish larvae, float in ocean currents and eat phytoplankton.
- Introduce the following new vocabulary words and add them to your word wall.
    - *Primary producer:* organisms, such as plants and phytoplankton, that can produce their own food through photosynthesis or chemosynthesis; also called autotrophs
    - *Primary consumer:* organism that eats producers; herbivores
    - *Secondary consumer:* organism that eats primary consumers; includes carnivores and omnivores
    - *Tertiary consumer:* carnivore that mostly eats other carnivores
    - *Apex predator:* species at the top of the food chain, with no predators of its own; also called an alpha predator or top predator
    - *Decomposers:* organisms that break down dead organic material; also sometimes referred to as detritivores

    - Trophic *level*: an organism's level on the food chain, whether producer, consumer, or decomposer

- Distribute the *Trophic Level Card Sort*. Instruct students to decide, in their groups, what trophic level each organism belongs to.

    - You may wish to hand out poster board, chart paper, or dry erase markers during this portion of the activity so that students can create a surface on which to organize and label the six trophic levels.
    - Some of the organisms will be unfamiliar to students, and many groups may struggle to classify unfamiliar organisms. Remind students that they are not being graded in this activity on the correctness of their answers, and that they should use any available clues or reasonable guesses to guide their choices. There is also a category for *Other/Not Sure*.

- After groups have finished sorting, go over the answers using the *Trophic Level Card Sort Answer Key*.
- Then, ask if they can think of any organisms that are part of the marine environment but not featured in this card sort. Encourage students to think of organisms as well as their trophic level.

    - Possible responses:

        - Phytoplankton, including many types of algae, are producers.
        - Krill eat phytoplankton, so they are primary consumers.
        - Baleen whales, such as the blue whale, though very large, tend to eat krill, so they would be classified as secondary consumers.
        - Seabirds, such as seagulls and Laysan albatrosses, consume a variety of other organisms, including squid, fish, and crustaceans, so they would be considered tertiary consumers.
        - Many crabs are decomposers, as are many bacteria, fungi, and worms.

2. Introduce the concepts of ingestion and entanglement.

- Tell students that each of these organisms can be impacted by plastics in different ways. Have students work in their groups to brainstorm ways that plastics can impact different organisms.
- Rather than define the concepts of ingestion and entanglement directly, lead the following concept development activity.

    - Prepare chart paper or space on a whiteboard with three unlabeled columns.

    - The first column will represent ingestion impacts.
    - The second column will represent entanglement impacts.
    - The third column will represent other impacts.

- As student groups share their brainstormed lists of possible plastic impacts, record their responses in the appropriate column.
- After hearing from each group, ask: *Why are these responses grouped in three separate columns?*

    - The first column involves eating plastics; the second column involves getting trapped by plastics; and the third column is other impacts.

- Now ask students to help define the two new vocabulary words:

    - *Ingestion:* the act of eating or consuming
    - *Entanglement:* the state of being trapped or caught in something

- Add these entries to your class unit word wall and ask teams to create a sentence for their glossaries.

    - Encourage students to use other forms of both words, such as *ingested* or *entangled*, in their sentences.

3. Facilitate a jigsaw activity about the varied ways plastics affect organisms at different trophic levels.

- Explain that to learn more about how different kinds of plastics affect different kinds of organisms, publishing teams will split up for a jigsaw activity and then reassemble at the end of class to share what they learned. Each jigsaw group will become experts on one group of organisms, from primary consumers to decomposers, which they will then teach their publishing team about when they reunite.

    - Note that producers are not included in this jigsaw because they do not ingest plastics. However, new research suggests that plastics do have a variety of impacts on phytoplankton, including adhering to their surfaces and altering their rates of growth and photosynthesis.

- Divide the class into their jigsaw groups. Distribute one of the following four *Plastic Impacts* handouts to each group (multiple groups can focus on the same topic as needed).

    - *Plastic Impacts: Primary Consumers*

- *Plastic Impacts: Secondary and Tertiary Consumers*
- *Plastic Impacts: Apex Predators*
- *Plastic Impacts: Decomposers*

- Provide instructions for the jigsaw:

  - Point out that the first question on each handout asks students to create a list of organisms in their assigned trophic level. Then, students will read the resources provided and answer the related questions.
  - Advise students that they may not need to read the entire article, but can skim for key information based on the questions.
  - Some articles may not explicitly state how ingestion and/or entanglement affect specific organisms. In these cases, push students to formulate reasonable hypotheses, and to confront the very real uncertainties that plague researchers and policymakers.
  - When they finish, groups should fill in their assigned row on the back of their *Plastic Impacts* handout in preparation to share information with their project group.

- Assess student learning before students return to their publishing teams to ensure they share accurate information. Use the *Plastic Impacts Answer Key* as a guide while observing the jigsaw groups and/or reviewing their responses.
- Finally, bring students back into their publishing teams. Instruct them to take turns sharing the information they learned in their jigsaw groups and fill in the rest of the table on the back of their handouts.

4. Conclude the activity by summarizing and connecting it to the unit project.

- On an exit ticket, ask students the following summarizing questions:

  - *Which marine trophic level is the most impacted by plastics? Explain why.*
  - *Which type of plastic impact is the most harmful for marine organisms? Explain why.*

- Tell students that in their final project, they must include a profile of a unique marine organism. It can be any organism, but it must be unique: It should not be one of the organisms profiled in this activity, and it should not be an organism shared by another project group. In their profile, they must include basic information about the organism and how it is impacted by plastics.
- Direct students to spend any remaining class time discussing which organism to choose for this focal profile.

Informal Assessment

Students' participation in the trophic level card sorting discussion and their exit tickets provide insights into students' developing understanding and ideas about the cycling of matter in marine ecosystems; these should be collected by the teacher. Their completion of the *Plastic Impacts* handouts demonstrates their ability to determine the main ideas in scientific texts; these should be kept in the publishing teams' project folders.

Extending the Learning

Consider using these related encyclopedic entries to build a deeper understanding of each trophic level and different roles in the food web.

- *carnivores*
- *consumers*
- *decomposers*
- *herbivores*
- *omnivores*
- *producers*

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology

- Conservation

Learning Objectives

Students will:

- Differentiate between producers, primary consumers, secondary consumers, tertiary consumers, apex predators, and decomposers in marine ecosystems.
- Describe how ingestion and entanglement impact organisms at each level of the food web.

Teaching Approach

- Project-based learning

Teaching Methods

- Cooperative learning
- Jigsaw
- Reading

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Learning and Innovation Skills
    - Communication and Collaboration
- 21st Century Themes
  - Environmental Literacy
- Science and Engineering Practices
  - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

NATIONAL GEOGRAPHY STANDARDS

• **Standard 8:**
The characteristics and spatial distribution of ecosystems and biomes on Earth's surface

NEXT GENERATION SCIENCE STANDARDS

• **LS2.B Cycles of Matter and Energy Transfer in Ecosystems:**
Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms

in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

- **Science and Engineering Practice 8:**

Obtaining, evaluating, and communicating information

Preparation

What You'll Need

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per pair, Printer, Projector

PHYSICAL SPACE

- Classroom

SETUP

Cards for the card sort should be printed and cut out in advance. You may wish to print these on cardstock if you intend to use them multiple times with different classes.

Prior to this activity, choose jigsaw groups for your students. The readings presented in this jigsaw activity are more uniform in terms of reading level and format than those in the previous jigsaw.

GROUPING

- Jigsaw grouping
- Small-group work

BACKGROUND & VOCABULARY

Background Information

Nearly 250,000 species are known to live in the oceans. Meanwhile, as many as 91 percent of ocean species still have not been classified, and 95 percent of the oceans remain unexplored. Ocean food webs, therefore, are complex and difficult to study. In some ways, they seem like a

bizarre mirror image of terrestrial food webs. Stationary creatures, like coral, seem like plants, but are actually consumers (although they live symbiotically with photosynthetic algae called zooxanthellae). Huge animals, such as the whale shark, subsist primarily on plankton, while tiny creatures, such as seahorses, are predators. The water column contains so much detritus, known as marine snow, that many filter-feeding animals that eat plankton could also be considered decomposers. Adding to the confusion, many marine animals are opportunistic feeders that will take advantage of almost any available food source, so they could be considered to occupy more than one trophic level. This confusion may become apparent to some of the students as they learn more about the marine food web. Nevertheless, understanding how organisms in different habitats and niches interact with plastics of different sizes allows students to appreciate both the beauty of the ocean ecosystem and the complexity of dealing with the problem of plastics.

Prior Knowledge

[]

Recommended Prior Activities

- Autopsy of an Albatross
- Follow the Friendly Floatees
- Magazine Design Workshop I
- Plastics Aplenty
- The Life Cycle of Plastics

Vocabulary

Term	Part of Speech	Definition
apex predator	*noun*	species at the top of the food chain, with no predators of its own. Also called an alpha predator or top predator.
decomposer	*noun*	organism that breaks down dead organic material; also sometimes referred to as detritivores
entanglement	*noun*	the state of being trapped or caught in something
ingestion	*noun*	the act of eating or consuming.
primary consumer	*noun*	organism that eats producers; herbivores.

Term	Part of Speech	Definition
primary producer	*noun*	organisms, such as plants and phytoplankton, that can produce their own food through photosynthesis or chemosynthesis; also called autotrophs.