

## Lesson 8

# PLASTICS IN MARINE LIFE

### Lesson Focus

In this lesson students will learn how microplastics transfer from smaller animals to larger animals through their food chain, resulting in a higher concentration of microplastics and the chemicals they emit in the apex (top) predator.

### Lesson Objective

Students will be able to correctly describe how microplastics are moved up a food chain by bigger fish consuming smaller fish that have eaten microplastics.

Grade Level	Duration	Subject Area	Vocabulary
K-3	1 Hour	Science	food chain, plankton, marine debris, microplastics, biodegrade, bioaccumulation, biomagnification

### Louisiana Student Standards for Science

#### **K-ESS3-3**

Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

#### **3-LS4-4**

Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there change as well.

### Materials List

#### **For Teacher Demonstrations**

- 1 pint-sized jar (preferably a Mason jar) filled  $\frac{3}{4}$  with water and with torn strips of newspaper - the weekly ad papers from the grocery store are free, colorful, and work well
- 1 plastic grocery bag
- 1 piece of broccoli or onion sealed in a plastic bag or plastic container for a demonstration of how plastics absorb odors

#### **For Grades K-1**

##### **Per Student**

- 1 copy of **Activity Sheet #4**

##### **Per Group**

- 1 copy of **Activity Sheet #1**
- Prepared fish (see advanced preparation)
- 1 envelope with 30 lentils (25 green and 5 red)

### **For Grades 2-3**

#### **Per Student**

- 1 scissors
- 1 copy of **Activity Sheet #2** and **Activity Sheet #4**

#### **Per Group**

- 1 side of a clear plastic sheet protector
- 4 different colored permanent markers
- 1 envelope with 30 lentils (25 green and 5 red)
- 1 copy of **Activity Sheet #1** and **Activity Sheet #3**

### **Activity Sheets**

- The Great Pacific Garbage Patch
- Plastics In Marine Life Worksheet
- Fish Template
- Fish Activity
- Classroom Plastic Inventory

### **Advance Preparation**

1. **How Large Plastic Objects Breakdown into Microplastics Demonstration:** Before class begins fill a pint-sized jar  $\frac{3}{4}$  full of water. If possible, put the jar with water in the microwave for 1 minute to heat the water. Tear five strips of the newspaper (approximately 3" x 5"), place in jar, put on jar lid, and let sit for at least five minutes. This will give the paper time to absorb the water and help it break down quicker.
2. **How Plastics Absorb Odors Demonstration:** The night before the lesson put a piece of broccoli or onion in a small plastic container or sealed bag. Leave it overnight at room temperature.
3. Prepare 1 envelope filled with 30 lentils (25 green and 5 red) for each group.
4. Cut the sheet protector into 2 pieces and make copies of the activity sheets.
5. **For Grades K – 1:** Trace and cut the 4 fish from the sheet protectors (each fish should be traced in a different colored pen – see **Activity Sheet #2**).

### **Background Information**

Globally, our waterways and marine environments are contaminated by plastic debris. Eighty percent of **marine debris** or litter in the oceans originates on land and is carried into our waterways by stormwater runoff, rain, wind, and other actions that move litter. Plastic marine debris is of considerable concern because of its harmful effects on water quality and marine life and because it does not fully decompose. Plastics enter the waterways as large plastic items such as beverage bottles and bags or as small pieces 5mm in size and smaller known as **microplastics**. Small pieces of laundry fibers from synthetic textiles enter the waterways from washing machines and are one of the greatest sources of microplastics. Large plastic items enter waterways in a variety of ways: improper disposal of trash, littering, and stormwater runoff. Once in the waterways, plastics begin biodegrading. Plastics do not completely **biodegrade** or break down like natural materials do. Instead, as plastics are exposed to the sun, water, and movement from waves, they fragment and break up into smaller and smaller pieces. Plastic pieces 5mm or less are known as microplastics.

Microplastics' small size and ability to float make them resemble fish eggs and **plankton** (microscopic plants and animals) that fish and other aquatic animals eat. However, the ingestion of microplastics may not only be driven by a chance encounter with microplastics. Scientists believe that fish and other animals are attracted to the smell of microplastics. Microplastics absorb odors much like plastic food containers or bags. Many **phytoplankton** (microscopic plants known as algae) create a chemical called dimethyl sulfide. Dimethyl sulfide is one of the main components responsible for the characteristic odor of the ocean (St. Laurent, 2019). Dimethyl sulfide is also found in vegetables like cabbage, broccoli and onions. It is responsible for their characteristic odor. Scientists believe that zooplankton (microscopic aquatic animals) and larger animals may be tempted to eat microplastics because they are infused with the 'dinner scent' of dimethyl sulfide (St. Laurent, 2019).

Once microplastics are swallowed by an animal the plastic pieces cannot be broken down by digestion. These plastics remain in the animal's stomach and take up space, giving the animal a feeling of fullness. This means they are less likely to want to eat and, even if they do eat, there is less room for nutritious food in their stomach. In addition, plastics often attract toxic substances to their surfaces, so these toxins end up remaining in the animal as well. Some of these toxins can even be permanently stored in their tissues. These toxic substances behave like ink in a skin tattoo. A tattoo stays on a person's skin their whole life because their body cannot break down the tattoo ink. This phenomenon of plastics and toxins building up in an animal is called **bioaccumulation**.

Now, imagine the concept of bioaccumulation happening in a **food chain**. A food chain shows the order in which plants and animals get their food and energy. If a small fish mistakes microplastics for algae and eats them, the chemicals in and on the plastics cannot be broken down by the fish's body and are stored in its tissues. Next, a medium-sized fish eats the small fish, now the medium-sized fish has these chemicals stored in its tissues. This is in addition to the microplastics and chemicals that medium fish had already eaten along the way. Then, a large fish eats the medium-sized fish. That large fish gets all the microplastics and all the chemicals eaten by the small and medium fish. This is in addition to all the microplastics that large fish ate on its own. This increasing concentration or buildup of microplastics and chemicals in the medium and large fish is called **biomagnification**. Sadly, biomagnification is not limited to ocean life, it can happen in all wildlife and in humans.

## References

- Boucher, J., & Friot, D. (2007). Primary Microplastics in the Oceans: A global evaluation of sources. <https://portals.iucn.org/library/sites/library/files/documents/2017-002-En.pdf>
- NOAA Marine Debris Program. (Jan 1, 2024). Plastic. <https://marinedebris.noaa.gov/what-marine-debris/plastic>
- St. Laurent, K. (May 27, 2019). Microplastics: Smells like Dinner. <https://envirobites.org/2019/05/27/microplastics-smells-like-dinner>

## Procedure

### Engage – 15 Minutes

1. Project the image of the The Great Pacific Garbage Patch (Korotkin Associates website) and distribute **Activity Sheet #1**.
2. Ask students the following questions which are intended to get students thinking about the problems that improperly discarded plastic items are causing. Acknowledge all answers without correcting the students. This is also a way to learn their prior knowledge on this topic.
  - **What do you see in this picture of the Great Pacific Garbage Patch?** *A variety of plastic items of various sizes. Many items are hard to identify.*
  - **What do you think will eventually happen to all the plastic trash in the water?** *It will breakdown into the small pieces that we see in the picture and eventually into microscopic pieces called microplastics.*
3. **Demonstration: Large Plastic Objects Breakdown into Microplastics.**
  - Explain that when litter, like a plastic bag (hold up a plastic bag), enters the ocean, the sun and waves will break it into small pieces like we saw in the picture. These pieces of plastic will eventually break down into tiny pieces called microplastics. These tiny pieces look and smell like food to animals, and they eat them.
  - Hold up the jar filled with water and newspaper strips.
  - Explain that you are going to show them how this could happen with this jar of water.
  - Explain that you are using paper in this demonstration instead of plastic because paper breaks down quickly. Plastic is tough and breaks down much more slowly.
  - Shake the jar vigorously until the paper breaks up into small pieces.
  - Hold the jar up to the light. Then walk around and show how the paper has broken up into small pieces floating in the water like microplastics.
4. **How Plastics Absorb Odors Demonstration.**
  - Hold up the broccoli or onion sealed in a plastic bag or plastic container.
  - Ask students if they have smelled broccoli or onion. Explain that a chemical in broccoli and onions causes them to smell.
  - Open the container or bag and discard the broccoli or onion.
  - Walk around and let students smell the empty container or let them pass it around.
  - Explain that the plastic still smells like broccoli or onions because the plastic has absorbed the odor.
  - Some plankton, phytoplankton (microscopic plants), have a strong smell because it has this same chemical.
  - Explain that plastics floating in the ocean absorb the odor of this plankton. Animals are attracted to this plastic because it looks and smells like food and will eat it thinking the tiny plastic pieces are food.
  - Show this video of zooplankton eating microplastics.  
<https://www.youtube.com/watch?v=beUhzQAnM>
5. Ask, **What are the two ways marine animals might confuse microplastics for food?** *Microplastics can look like food because of their small size and smell like the plankton animals like to eat.*
6. Ask, **What do you think will eventually happen to all the plastic trash in the water?** *It will break down into small pieces called microplastics just like the paper in the jar.*

### Explore – 30 Minutes

1. Divide students up into groups of four. Distribute the materials.
  - **For Grades K-1:** Distribute prepared fish and **Activity Sheet #4** only.
  - **For Grades 2-3:** Distribute **Activity Sheets #2, #3** and **#4**. Each student should trace one of the four fish on the group's plastic sheet in a different colored marker than their teammates. Students should cut out their plastic fish creating a set of four different colored and sized fish.
2. **For All Grades:** Distribute the prepared envelopes with 30 lentils. Explain that the green lentils will represent nutritious food (plankton) consumed or eaten by the fish and the red lentils will represent the microplastics consumed by the fish.
3. One student will pull 10 lentils out of their group envelope without looking and set them on their desk. The student will then count the number of microplastics (red lentils) their fish has eaten and draw a dot on their fish for each microplastic their fish consumed. Then, the student will return all the lentils to the envelope and hand the envelope to the next student. Students will repeat this for each one of the plastic fish.
4. Starting with the smallest fish on the bottom, students will make a stack of their fish from smallest to largest. The easiest way to stack the fish is to align the fish's tails. Students should see the dots, representing the microplastics that have been eaten and passed up the food chain, when they stack their fish.
  - **For Grades K-1:** Demonstrate how to draw microplastics in the table on **Activity Sheet #4**. Students draw microplastics and record the number of microplastics as each larger fish is added to the stack.
  - **For Grades 2-3:** Students should record the number of microplastics on their data table on **Activity Sheet #2** as each larger fish is added to the stack. When the activity is finished, the largest fish should be on top of the stack. Students should complete the remainder of **Activity Sheet #2** and **Activity Sheet #4**.

### Explain – 10 Minutes

1. Ask, **What do the green lentils represent?** *Food consumed or eaten by the fish. What do the red lentils represent?* *Microplastics consumed or eaten by the fish.*
2. Ask, **How many microplastics do you see in the largest fish?** *Students should count the number of dots they see in the stack of fish.*
3. Ask, **When you stacked a bigger fish on top of a smaller fish what did it represent or show in the food chain?** *When the bigger fish was stacked on a smaller fish, this represented the bigger fish eating the smaller fish.*
4. Ask, **What is happening to the number of microplastics as you move up the food chain?** *The number of microplastics is increasing very quickly. This is called biomagnification.*
5. Ask, **Which fish has the largest number of microplastics?** *The biggest fish (Fish 4). Which has the smallest number of microplastics?* *The smallest fish (Fish 1).*
6. Ask, **What are two harmful effects that microplastics have on fish that mistakenly eat them?** *Microplastics take up room in the fish's stomach, which can lead to starvation. Microplastics have toxins or chemicals on the surface of the plastic, and these toxins can cause the fish to become ill.*

### Expand – 25 Minutes (Optional)

1. Students will listen to the book **A Planet Full of Plastic: and how you can help** by Neal Layton. Read aloud by Mrs. Smalley: <https://www.youtube.com/watch?v=mFJ8beW9ZCI> (6:38)
2. Ask students to answer these questions based on the book:
  - **What are some examples of plastic things found in the oceans?** *Answers will vary but should include plastic items listed in the book.*
  - **What does biodegrade mean?** *Biodegrade means to break down into small pieces.*
  - **What makes plastic super useful?** *It lasts an exceptionally long time.*
  - **How are microplastics formed?** *When larger plastics break down after a long time in the ocean and sun.*
  - **How do microplastics affect animals that eat them?** *They fill their stomachs until they are not hungry, and they have toxins that can cause problems for the animals that eat them.*
  - **What can you do to help?** *Answers may vary but should include examples of developing good habits of using less plastic, using reusable water bottles instead of single-use bottles, saying no to straws when they are offered to you, and picking up litter that they see on land before it gets to our waterways and oceans.*
3. Watch and discuss the National Ocean and Atmospheric Administration (NOAA) videos.
  - **TRASH TALK: What is Marine Debris?** Accessed at [https://oceanoday.noaa.gov/trashtalk\\_whatismarinedebris/welcome.html](https://oceanoday.noaa.gov/trashtalk_whatismarinedebris/welcome.html), (2:06) *This video explains what marine debris is and how it gets into the oceans.*
  - National Ocean and Atmospheric Administration (NOAA). **TRASH TALK: What is the Great Pacific Garbage Patch?** Accessed at [https://oceanoday.noaa.gov/trashtalk\\_garbagepatch/](https://oceanoday.noaa.gov/trashtalk_garbagepatch/) (2:08) *This video discusses what the Great Pacific Garbage Patch is and how it was formed.*
  - National Ocean and Atmospheric Administration (NOAA). **TRASH TALK: What Can We Do?** Accessed at [https://oceanoday.noaa.gov/trashtalk\\_plastics/welcome.html](https://oceanoday.noaa.gov/trashtalk_plastics/welcome.html) (2:22) *This video discusses how people produce too much waste. That waste ends up in the ocean when we litter or don't recycle. Plastic is an important part of our modern lives - we use it for a lot of good things! But we need to take responsibility for how much we use every day and where it goes when we're done with it.*
4. Then, revisit and discuss the above questions.
  - Ask your students if they would like to revise their answers to the above questions after watching the videos.

### Take Action

One way to keep plastic out of our oceans is to reduce our use of disposable or single-use plastics. Students should complete **Activity Sheet #5** by conducting a survey of the plastic items in their classroom and analyze the data. They should answer the following questions: How many of the plastic items identified in the classroom are not recyclable? How could the disposable items be reused? To reduce plastic waste, what could be used instead of the plastic item?

### Evaluate

1. **For Grades K-1: Activity Sheet #4**
2. **For Grades 2-3: Activity Sheets #2 and #4** ask students to explain their exploration.

### Online Resources

SciShow Kids. (2018). **How Plastic Hurts the World.**

Accessed at <https://www.youtube.com/watch?v=VUUUxOI715s> (4:21)

*This video discusses why recycling trash is one really important way that we can help the Earth stay clean! It's much better to recycle things than throw them away, but it's super important to recycle plastic! Jessi is here to tell you why!*

Lessplastic Thailand. (2020). **What is a Microplastic?**

Accessed at [https://www.youtube.com/watch?v=gTr\\_rxnMP-o](https://www.youtube.com/watch?v=gTr_rxnMP-o) (3:20)

*Learn about microplastics and the dangers they pose to the environment and our own health.*

### Children's Books

Burns, L.G. (2010). **Tracking Trash: Flotsam, Jetsam, and the Science of Ocean Motion.**

HarperCollins Publishers. ISBN-13: 9780547328607

*Readers learn how a scientist tracks trash using his knowledge of ocean currents. A Boston Globe–Horn Book Award Honor Book for Nonfiction. Ages 10 - 12 years.*

Du, A. (2019). **Microplastics and Me.**

Tumblehome Learning, Inc., Tumblehome, Inc. ISBN-13 978-1-943431-50-2

*Readers are engaged in an inspiring first account of a contemporary middle school girl tackling a global environmental problem through engineering. Ages 10 - 12 years.*

Layton, N. (2019). **A Planet Full of Plastic And how You Can Help.**

Martina Publishing. ISBN-13: 978-1526361769

*How plastic came to be, and how plastic affects the environment. Ages 9 - 12 years.*

*Read aloud by Mrs. Smalley: <https://www.youtube.com/watch?v=mFJ8beW9ZCI> (6:38)*

*Read aloud by Mr. Layton: [https://www.youtube.com/watch?v=-zfKrgS\\_H1Y](https://www.youtube.com/watch?v=-zfKrgS_H1Y) (8:50)*

Pincus, Meeg. (2021). **Ocean Soup: A Recipe for You, Me, and a Cleaner Sea.**

Sleeping Bear Press. ISBN-13: 978-1534111189

*Readers learn how our oceans are filled with plastics from water bottles to take-out containers to the teeny tiny particles you need a microscope to see. Ages 6 - 9 years.*

Smith-Llera, D. (2018). **Trash Vortex: How Plastic Pollution Is Choking The World's Oceans.**

Capstone Publishing. ISBN-13: 9780756557492

*Readers learn how plastics accumulate in the ocean and threaten organisms in the ocean. It also discusses microplastics. Ages 10 - 12 years.*

Vowell, C. (2021). **Nurdle and the Microplastics.**

Peahean Publishing. ISBN-13: 978-1838109950

*Nurdle, a lentil-sized piece of microplastic, meets other microplastics when he is washed into the ocean. Ages 10 - 12 years.*