Fishes Full of Fibers

Do my choices in clothing affect fish in the deep sea?

Overview

Microfibers are a type of microplastic, and they are being found everywhere we look for them. We find them in the atmosphere, bodies of water, and even inside organisms, including humans. In this lesson, students will learn about sources, transport, and the fate of microfibers as we explore how our clothing particles can end up in the bodies of deep sea lanternfish. Through hands-on and written activities, we will develop models and interpret data to inform microfiber mitigation solutions.

Essential Questions

- *What are microfibers and how are they produced?*
- *How do microfibers from our laundry end up in marine fish?*
- *Are the types of microfibers found in myctophids similar to that of clothing worn by students?*
- *What are mitigation strategies to help this problem?*

Learning Goals

Students will learn the following:

- *Natural and synthetic microfibers are being ingested by organisms in the marine environment.*
- *Microfibers in the environment are a result of human activities, like doing laundry.*
- *Transport of microfibers throughout the environment can be simulated and modeled.*
- *Actions can be taken where individuals can have a positive impact on real world issues.*

Learning Objectives

Students will be able to:

- *demonstrate an understanding of what microfibers are and how they end up in the ocean life.*
- *create dot plots of data collected in the classroom and compare that with real scientist's data.*
- *simulate a laundry cycle to observe microfiber shedding.*
- *complete a guided reading activity with a science article.*
- *model fate and transport of microfibers.*
- *develop and share microfiber mitigation strategies.*

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Grade Level

6

Time

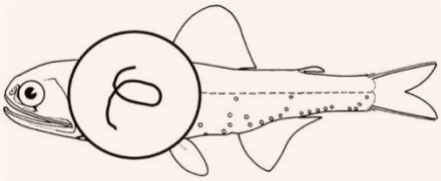
Five days

Anchoring Phenomenon

Fishes Full of Fibers

Driving Question

Do my choices in clothing affect fish in the deep sea?



Standards

Next Generation Science Standards

ESS3.C – Human Impacts on Earth Systems
ETS1.A – Defining and Delimiting Engineering Problems

Common Core Math Standards

6.DR.A.1
6.DR.C.3
6.RP.A.3

Introduction

Microfibers are a morphological subset under microplastics (particles <5 mm in any dimension) and are the most common type found in nature. These fibers persist in the environment because they are either made of synthetic materials like polyester and nylon, or they have been anthropogenically altered to resist breaking down, such as when flame retardants are added to carpet, for example. With the increase in production of textiles globally, these fibers will pose a greater threat to wildlife and humans as they continue to accumulate over time.

Myctophids, or lanternfishes, are sardine-sized fish that live in the pelagic zone and are one of the most abundant fishes in the ocean. To eat and avoid being eaten, myctophids perform diel vertical migration - meaning they spend the day about a kilometer deep in the ocean and swim up to the surface in huge masses at night. It is at the surface that they are likely consuming buoyant microplastic particles and subsequently bringing them back down with them during their return to the deep. Here, they are ecologically important prey for predators like marine mammals and commercially relevant fish species and have the potential to bioaccumulate and biomagnify up the food web.

Using myctophids in museum collections, we can begin to answer what, where, and why microfibers are being ingested by these fish. Broadly, these data can help scientists and policy makers enact informed mitigation strategies to combat this type of pollutant. In this lesson, students will come away with an understanding of how humans can make an impact, positively or negatively, on organisms far out of sight.

Lesson Procedure

ENGAGE

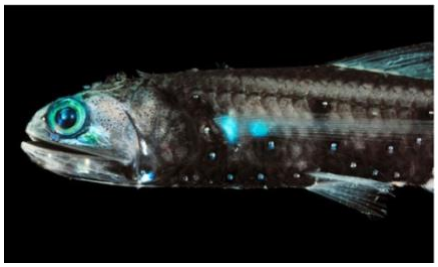
On Day 1, the students will be introduced to the star of this week's lesson, the mighty myctophid, and the issue that is currently being researched at Oregon State University. Guidance is provided in the Day 1 Teacher Guide and in the speaker notes of the Day 1 Anchoring Phenomenon Slideshow.

The slideshow begins by having students make guesses about what they are looking at; a series of images which progressively zoom out to reveal the observable phenomenon - a fish with a fiber in its stomach! This fish species is an important member of marine food webs and can experience negative health effects from consuming microfibers.

LESSON RESOURCES

Key Vocabulary

Anthropogenic
Bioaccumulate
Biomagnify
Buoyant
Diel vertical migration
Food web
Ingestion
Microfiber
Microplastic
Mitigation
Myctophid
Pelagic
Synthetic



Myctophid (lanternfish)
Photo: Deep sea fish wiki Fandom

Microfiber found in fish
Photo: Olivia Boisen, OSU

Day 1: Engage

- *Day 1 Teacher Guide (pdf)*
- *Day 1 Anchoring Phenomenon slides (ppt)(pdf)*

Photo: Olivia Boisen, OSU

After students have time to share their thoughts about the question on slide 7, they will watch an embedded video called The Story of Microfibers.

Next, there will be a short activity on slide 10 where students investigate their own clothing fibers stuck to a piece of tape. Day 1 ends with information about microfiber scientist Olivia Boisen and the actual research that inspired this lesson.

EXPLORE

On Day 2, students will read their shirt tags to explore clothing types, produce dot plots, and pose statistical questions based on these data. Guidance is provided in the Day 2 Teacher Guide.

First, use the Day 2 Fiber Type Matching Activity to help familiarize the students with categorizing their clothing as either "synthetic" or "natural". An answer key is provided.

Then, each student will plot their t-shirt tag data onto a class-wide dot plot of 100% natural, 100% synthetic, or blend categories. Students will copy the class data onto their Day 2 Fiber Type Data student worksheet, and complete ratio tables for the data collected.

Next, students are provided with a graphic that shows a school of myctophids containing varying types of microfibers. This example is based on real scientific data, and students will use these data to create another dot plot and ratio table.

Finally, the students will then learn about statistical questions and generate their own that can be answered with these data. To wrap up, they will pair up and trade questions to confirm their ability to formulate statistical questions.

EXPLAIN

On Day 3, students will develop understanding of concepts with a hands-on experiment. An overview of the experiment is provided in the Day 3 Teacher Guide. Following the procedures in the Microfiber Lesson Plan created by the Rozalia Project, students will use a Mason jar washing machine simulation to observe microfiber generation from textiles. The lesson includes a Microfiber Experiment Data Sheet on which they can record their findings. Students can alter variables such as detergent quantity and fabric type to produce different results. Similar to the way that myctophids are processed for microplastic studies, this liquid is passed through a filter to quantify the microfibers. This activity

Day 1: Engage, cont'd

- *Video: The Story of Microfibers [2:47]*

What is this and how did it get in the fish's stomach?

Career Connections

- *Researcher Bio: Olivia Boisen (pdf)*

Olivia Boisen, OSU

Day 2: Fiber Types

- *Day 2 Teacher Guide (pdf)*
- *Day 2 Fiber Type Matching Activity (pdf)*
- *Day 2 Fiber Type Matching Activity KEY (pdf)*
- *Day 2 Fiber Type Data student worksheet (pdf)(doc)*

Day 3: Effect of Washing Machines on Textiles

- *Day 3 Teacher Guide (pdf)*
- *Day 3 Microfiber Experiment Lesson Plan (pdf)(link)*
- *Day 3 Microfiber Experiment Data Sheet (pdf)(link)*

includes many options which could span one to several class periods depending on choice of filtration used and variables tested. Students will be able to utilize visual examples of microfibers to formalize their understanding of what microfibers are and how they are transported to the ocean while using multiple scientific practices: Ask Questions, Develop and Use Models, Plan and Carry out Investigations, Analyze and Interpret Data, Obtain, Evaluate, and Communicate Information.

ELABORATE

On Day 4, students will read a summary of a research article and use the information to create a 'story' about the journey of a microfiber through the environment. Detailed instructions are in the Day 4 Teacher Guide.

Students begin the day by completing a Guided Notes worksheet as they read a summary article, Microfibers from a Household Laundry Dryer (which is based on a scientific research article by Tao et al, 2022).

We know that ~80% of marine plastic pollution originates from land uses and several processes can transport this debris to the ocean. Using the article for background knowledge, students will use a Story of a Fiber Planning Tool to create a plan to model the possible movement of a microfiber through the environment, answering the question "how did this fiber end up in a deep sea fish?" Once students have received teacher approval, students use their plan to produce a "The Story of a Fiber". A Comic Book Template and Rubric are provided.

EVALUATE

To end the unit of study, Day 5 will be spent creating an infographic about microfiber mitigation. The Day 5 Teacher Guide provides instruction for this section, and includes an Assessment Rubric.

Begin the day by having the students watch the video Is Your Fleece Jacket Polluting the Ocean?, which summarizes what was taught in the unit. Then, use the Microfiber Mitigation Project slideshow to introduce the topic of mitigation and provide the prompt for the final assessment. They will see examples of products used to mitigate microfibers from laundry along with an example infographic. Their project should address two questions in a visually appealing way:

- Why are microfibers a problem in the ocean?
- What can we do to mitigate this problem of microfibers in the ocean?

Students can express a lot of creative freedom with this project.

Example of a clothing tag

Day 4: Research Article

- *Day 4 Teacher Guide (pdf)*
- *Guided Notes worksheet (pdf)(doc)*
- *Article: Microfibers from a Household Laundry Dryer (pdf)*
- *Source: Tao et al, 2022 (pdf) (link)*

Day 4, cont'd: Story of a Fiber

- *Story of a Fiber PlanningTool (pdf)(doc)*
- *Comic Book Template (pdf)*
- *Comic Book Rubric (pdf)*

Day 5: Microfiber Mitigation

- *Day 5 Teacher Guide (pdf)*
- *Assessment Rubric (pdf)*
- *Video: Is Your Fleece Jacket Polluting the Oceans? [6:04]*
- *Microfiber Mitigation Project (ppt)(pdf)*

Next Generation Science Standards

Performance Expectations:

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Science & Engineering Practices:

Engaging in Argument from Evidence
Constructing Explanations and Designing Solutions

Disciplinary Core Ideas:

ESS3.C: Human Impacts on Earth Systems
ETS1.A: Defining and Delimiting Engineering Problems

Crosscutting Concepts:

Cause and Effect
Influence of Science, Engineering, and Technology on Society and the Natural World

Common Core Math Standards

Math Practices:

MP.1 Make sense of problems and persevere in solving them
MP.4 Model with mathematics
MP.5 Use appropriate tools strategically
MP.6 Attend to precision

Common Core Math Standards:

6.DR.A.1 Formulate and recognize statistical investigative questions as those that anticipate changes in descriptive data related to the question and account for it in the answers.

6.DR.C.3 Analyze data representations and describe measures of center and variability of quantitative data using appropriate displays.

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems

Photo: Olivia Boisen, OSU

Acknowledgments

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See more lessons on the ORSEA webpage: oregoncoaststem.oregonstate.edu/orsea