

MARINE MICROFIBERS: HOW NATURALLY AND SYNTHETICALLY DYED MICROFIBERS IMPACT MARINE SPECIES

Kali Butler, Graduate Research Associate, Environmental & Soil Sciences

Lori Duncan, Assistant Professor, Biosystems Engineering

Andrea Ludwig, Associate Professor, Biosystems Engineering

Lynne Middleton, 4-H, Extension Specialist, 4-H Youth Development



Marine Microfibers

How Naturally and Synthetically dyed Microfibers impact Marine Species

Skill Level

Advanced (9th-12th graders)

Learner Outcomes - The learner will be able to:

- Define the word “microfiber”
- Compare cotton and polyester
- Describe differences between natural and synthetic dyes
- Rationalize how microfibers effect marine species

Time Needed – 40 minutes

Activity – 15 minutes Presentation – 15 minutes Assessment – 10 minutes

Materials List

- Two white Barbie t-shirts
- One mini electric washing machine toy
- Double A batteries
- 2 Clear water cups
- Red food coloring
- Clothing items with material tag intact

Teacher Talk

This activity can be messy. Be sure that youth are wearing “work” or old clothing or aprons.

Authors

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Introduction to Content

Microfibers are a subset of microplastics that occur when synthetic components of textiles degrade. As machine washing occurs, friction between the clothing pieces increases, causing tiny fabric fragments to break off and become released into our oceans. Microfiber pollution can occur under a wide range of textile materials including both natural and synthetic fibers, however, the effects that these have on marine wildlife vary based on material, dye and chemical finish applied. This lesson will introduce students to the harmful effects synthetic microfibers pose on marine wildlife. Students will examine how natural and synthetically dyed microfibers affect marine species by modeling a washing machine cycle for the corresponding groups. Additionally, students will compare cotton and polyester production to brainstorm ways to mitigate microfibers pollution.

Introduction to Methodology

Students will simulate a washing machine cycle to analyze how natural and synthetic microfiber dyes interact with marine species. This activity can be done in groups of four to six students depending on classroom size. For this experiment, classrooms will need to purchase one mini washing machine toy per group. Other materials are common household items such as: white doll shirts, food coloring, clear glasses, double A batteries, and any clothing items with the material tag intact.

Terms and Concepts

Microfiber – synthetic material with a diameter less than 1.3 denier

Denier - grams per 9,000 meters of fabric

Natural – existing or caused by nature

Synthetic- made by the combination of chemicals

Cotton – white fluffy subtropic plant used to produce fabric

Polyester – synthetic fabric made from gasoline

Friction – the resistance that one surface or objects encounters when moving over another

Setting the Stage/ Opening Questions

Say, “Laundry is much more than just an unpleasant chore. Each time we put our dirty clothes into the washing machine and press start, we create friction. This friction between clothing items causes tiny pieces of fabric to break off. These pieces are known as microfibers. Microfibers then travel via pipe, eventually flowing into our rivers and oceans. Due to their near-invisible size, fish often mistake these little microfibers for dinner, leading to dangerous side effects.”

Say, “The composition of microfiber plays a significant role on the impact of marine species. Microfibers made from natural materials typically result in less harmful effects compared to those made from synthetic materials. This activity will investigate how various natural and synthetic dyes affect the side effects experienced by marine species.”

Strategies to Increase Student Engagement

- Bring clothing items from home with the tag still intact. Students can read tags and decipher which fabrics are natural or synthetic.
- Students can watch this video overviewing how friction in the washing machine causes clothing to breakdown, releasing microfibers into our waterways:

[The Story of Microfibers](#)

Ask, “What is friction?” **ANSWER** - Friction is the resistance that one surface or object encounters when moving over another. It occurs when two materials come in contact and can result from various factors, including roughness of the surfaces, the materials involved, and the force pressing them together.

Students are expected to mention that friction is what slows objects. They may mention that this happens when an object interacts with another object. To encourage further understanding, instruct the students to rub their hands together as if it was cold outside.

Explain that heat created from this is a result of friction. Say, “The friction created by your hands rubbing together caused an increase in energy.”

Now, ask students to rub two pieces of clothing material together. This is expected to cause lint to become visible in the air.

Explain that this, too, is increasing energy, causing tiny pieces of these clothes to break off. Say, “Unfortunately, when clothes rub against each other, we don’t get to see the fabric materials breaking off until they end up in the belly of a fish.”

Say, “Natural fabrics are made from materials grown in nature. Cotton is the most popular, making up 22 percent of all fabrics purchased. That’s more than a million tons of cotton fabric produced each year. Natural fabrics can be made from wool from sheep, hemp seeds, bamboo and silk. A general rule of thumb is if it can be grown on a farm or produced by an animal, it is a natural fabric.”



Figure 1: Natural Fabric Sources

Ask, “What are some examples of synthetic fabrics?” Students are expected to say nylon, polyester and spandex.

Elaborate that these are examples of synthetics fabrics.

Say, “Synthetic fabrics are made from different manufactured chemical combinations. Chemicals are made from tiny molecules mixed to form another substance.”

Ask students to reflect on what water is made of. Explain that water is made of oxygen and hydrogen combining. Continue, “The difference between water and synthetic chemicals is water is made in nature and synthetic chemicals are made in a laboratory.”

Encourage students to read the tags of the clothing items distributed and ask them to call out words they don't recognize. Since synthetic fabrics are not created by nature, they aren't able to interact with animals and plants in a positive way. Nature simply does not recognize these materials so they accumulate in spaces they shouldn't.

Synthetic fabrics result in large quantities of water pollution and greenhouse gases emitted during the production stage. These materials also can't be broken down over time, so they last in landfills or waterways long after our lifetimes.



Figure 2: Polyester Factory

Say, "Using what we have learned about natural and synthetic fabrics, what do you think the difference is between natural and synthetic dyes? Natural and synthetic dyes follow the same rules we previously discussed. Natural dyes are made from plant and animal materials while synthetic dyes are made from chemicals."

Continue, "Beets, indigo, and black walnuts are some examples of plants that can make natural dyes. Can you think of any others? (Berries! Fun fact: Cleopatra used to use berries to make her cheeks rosy red.)"

Experience

Part I. Exploring Friction

Allow students to rub clothing materials creating friction. Have the students notice that small pieces are breaking off into the air. Then ask students what causes friction to occur in the washing machine. Explain to students that the spinning motion of the washing machine causes clothes to rub against each other similar to the activity they just performed. This friction created in the

Notes

washing machine causes small pieces of clothing, of all colors, to break off and travel towards the ocean.

Part II. Do you know where your clothes come from?

Have the students locate the material tags in their T-shirts. They can use a buddy's help locating the tags. Have the students raise their hand if more than 50 percent of their shirt is made from natural fabrics. Tally the students. Following this, have the students who have T-shirts made from synthetic fabrics raise their hand. Tally the students. Ask what students think the differences are between natural and synthetic fabrics. Additionally, have the students reflect on what consequences their natural and synthetic "ratio" may have in the real world.

Part III. Laundry Experiment

Prepare Barbie shirts by dyeing one shirt (per group) red with red food coloring.

1. Split students into groups of six, each receiving one washing machine gadget, two clear cups, one white doll shirt, one red doll shirt, and two fish figurines.
2. Explain to students that the red shirt represents a cotton shirt with synthetic dyes, while the white shirt represents a cotton shirt with natural dyes.
3. Add water and the white doll shirt to the washing machine and press start.
4. Once the cycle ends, remove the barbie shirt and dump the leftover water into a clear cup.
5. Repeat steps three and four for the red doll shirt.
6. Once finished, have students record their observations, noting color differences between the two cups.

Share

Ask students, "Which cup contains water that is safe to drink? Do you think it is safe for fish to drink water from the red barbie T-shirt?"

Ask students, "Knowing that dyes travel from our washing machine to our ocean, which microfiber do you think would have a greater effect on wildlife. One dyed with natural dyes (beets), or one dyed with synthetic dyes (like azo). Why?"

Process

To generate further understanding ask students, "Why do you think synthetic dye causes more harm to ocean environments?"

After student participation, re-emphasize those synthetic materials, including dyes that are not found in nature leaving animals confused on whether these materials are friend or foe.

Say, "Synthetic components cannot be digested in animals, so they stay inside the animal's belly causing harmful effects over time."

Generalize

Explain, "You get home from school and your mom asks you to bring your dirty clothes to the laundry room. You walk into your room and see your clothes all over your bedroom. Should you throw all the clothes into the dirty hamper and bring them to your mom to put in the washing machine, or should you sort your clothes and only add the truly dirty clothes into your laundry basket? What kind of impact do you hypothesize each choice would have on marine species, why or why not?"

Apply

Say, "Five years have passed since this lesson and you, and your best friend, want new outfits for a party. You could go to the mall and pick a new trendy outfit made from synthetic materials, you could purchase secondhand items from a local thrift store, or you could purchase from a small local business that uses natural materials. Remembering this lesson, you try to advise your friend to pick which option? When she asks why, what could be a possible response?"

Ask, "Based on this lesson, what ideas do you think could help reduce microfiber pollution?"

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Student Worksheet

Name: _____ Date: _____

A. Experiment Questions

What causes friction to occur in the washing machine?

How does nature interact with natural dyes. How is this different than how nature interacts with synthetic dyes?

Where did your clothes today truly come from? Was it a farm or a factory?

B. Sorting Activity - Draw a line from the material name into the corresponding natural and synthetic bins.

Natural

Wool

Nylon

Spandex

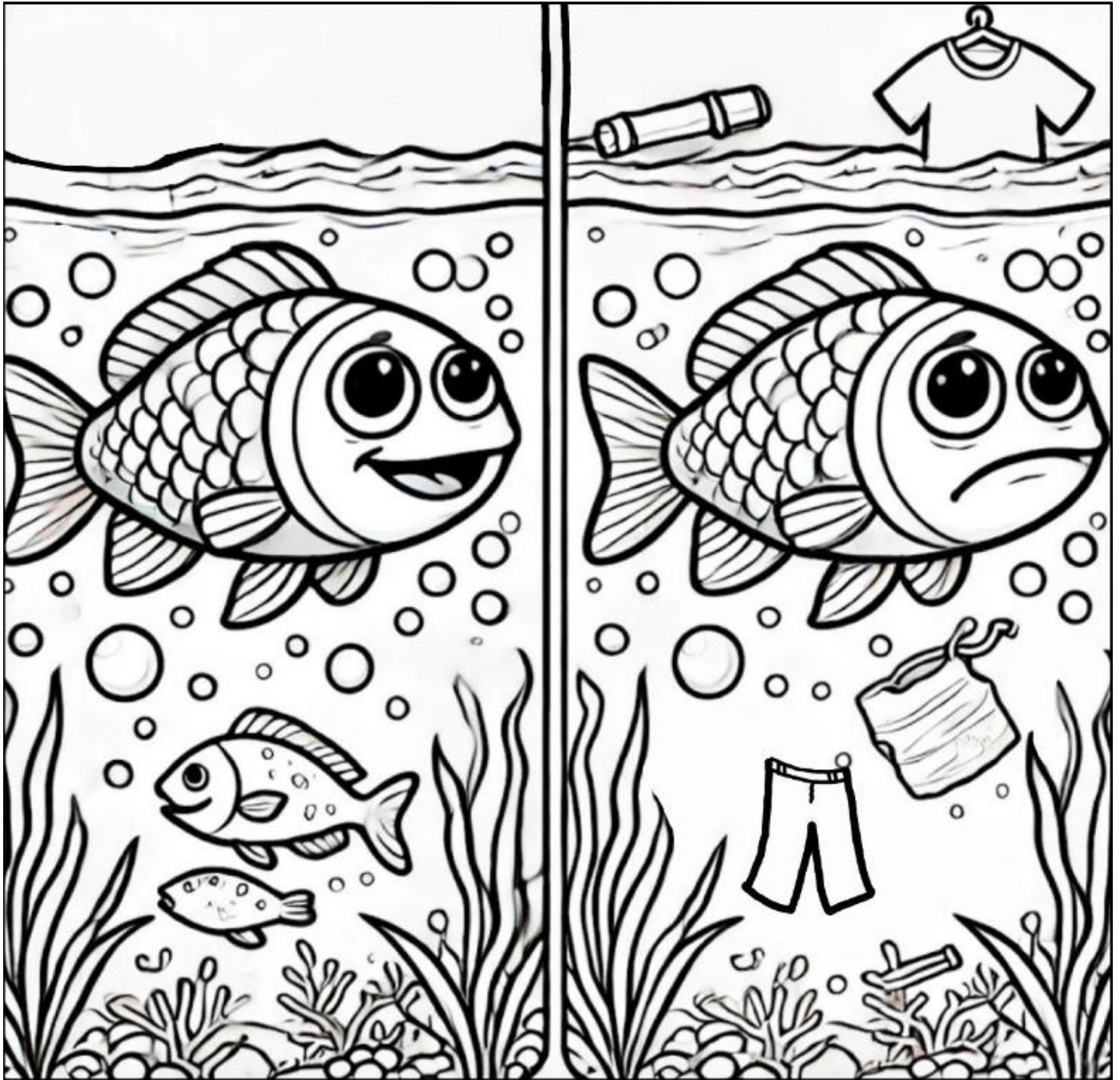
Beets

Indigo

Synthetic

A. Fish Coloring Activity – Color each ocean scene to your liking.

List some clear differences between each ocean environment? How do you think these impact marine species?





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