ROZALIA PROJECT MARINE DEBRIS CURRICULUM

MICROFIBER EXPERIMENT

THE EFFECT OF WASHING MACHINES ON TEXTILES

GRADE LEVEL	6-8
NGS STANDARDS	MS-ESS3-3

MICROFIBER LESSON PLAN: *THE EFFECT OF WASHING MACHINES ON TEXTILES*

GOALS:

For learners to discover that microfibers are present in our environment with hands-on science activities. Learners will engage with the microfiber problem through its relationship with washing machines and then discuss ways to mitigate or avoid this from continuing to happen. Learners will design and conduct a hands-on science experiment.

TIME NEEDED:

Approximate 50 minutes available not including set up or clean up. Note: If using gravity as a filtering method, this could take over a day.

GRADE LEVEL:

6-8 (can be adapted for higher or lower grades, see extensions)

NEXT GENERATION SCIENCE STANDARDS:

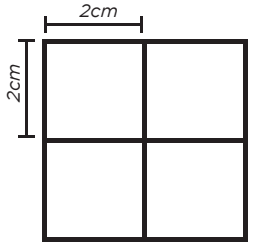
MS - ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

SUPPLIES:

In the teaching kit there will be 6 sets of:

- *vacuum pump*
- *tubing*
- *ceramic funnnel*
- *filtering glass flask*
- *mason jars with lids*
- *tweezers*
- *thermometer*
- *filter paper**
- *piece of fabric*
- *metal petri dishes*
- *data sheets*
- *soap*
- *magnifying lens*
- *rubber stopper*

*If you do not have a microscope, please draw a 2cm x 2 cm grid pattern with pencil on each filter paper data sheets.



Additionally need: access to hot and cold water, a stereo microscope, measuring cup, and ruler.

Alternative supplies if teaching lessons remotely: funnel, 1 container with tight fitting lid, soap, bowl, coffee filter, magnifying lens, tweezers, piece of fabric (dark color), measuring cup, ruler, microscope (if available) magnifying apps available for free for smart devices.

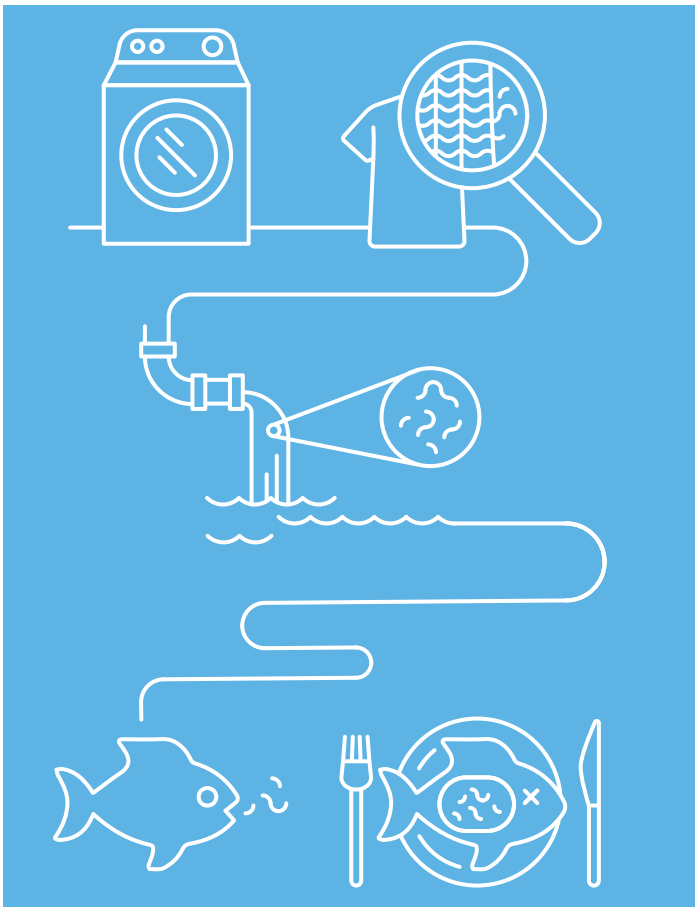
BACKGROUND INFORMATION FOR EDUCATORS:

What are microfibers?

Simply put, microfibers are tiny fibers. They are so small that they can be hard to see without a microscope or magnifying lens. Microfibers have a wide range of sizes and some can be less than 3 microns! To compare, one strand of human hair is around 70 microns in diameter. Microfibers are pieces of fibers that break off the longer fibers that make up our clothes. This happens during washing, drying and even while just wearing our clothes. Microfibers shed in our washing machines and can end up in our waterways and environment after we do our laundry. They are so small that most filters and nets are not designed to trap them. Microfibers can be synthetic, or they might be natural fibers potentially covered in dyes and chemicals since they can come from all of the clothes and fabrics we use in our homes!

Where do we find microfibers?

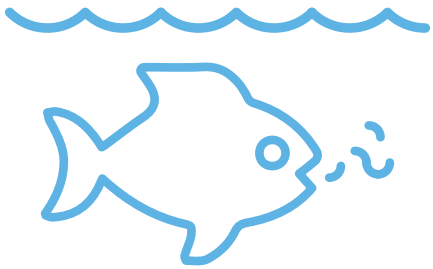
Microfibers find their way into our water, our soil, and our air. We shed them from our clothes as we wear, wash, and dry them. Since they are so small and not stopped by most filters, they are able to escape our water treatment plants and find their way into our rivers, lakes, and oceans. Some travel through the air and make their way into our soils. Studies have shown that plastic microfibers are in the majority of the waters we drink around the world, both tap and bottled.



BACKGROUND INFORMATION FOR EDUCATORS CONTINUED:

What are the impacts from microfibers on the environment?

We are still learning what the impacts of microfibers could be to our health and our environment. Studies are showing that ingesting microplastics, which include microfibers, can cause animals to change their behaviors, to become sick and even die. The animals we eat are possibly eating microfibers. The bottom line is, we really don't know the implications of so much plastic in our environment, or in our bodies.



What do we know about microfibers and washing machines?

There are many factors that contribute to our clothes shedding fibers in the wash. If we make choices such as cold water vs. hot water, front loader vs. top loader, liquid detergent vs. powdered and delicate cycle vs. heavy duty cycle, these choices would cause less shedding. Upstream of the washing machine and clothing, there is room for innovation and redesign of industry including better filters for washing machines and improvement in textiles to make our clothes more durable. In the stream of our wash experience, there is opportunity for consumer scale solutions that exist today including capture balls, such as the Cora Ball, wash bag, or external filter. Downstream of the effluent water, there is opportunity to improve our infrastructure including septic systems and water treatment facilities. In all of these areas there is great room for innovative solutions.

Sources:

From the Rozalia Project: Stop Microfiber Pollution

Plastics in water article: https://bit.ly/31h3hlT

Plastic in our drinking waters, air, and soil.: https://n.pr/2NS1XOj

Short intro to plastic microfibers. https://bit.ly/2Z0CzMZ

Note, microfibers are shed from all types of materials, not just synthetic clothing.

Microfiber article: https://bit.ly/31lyVJo

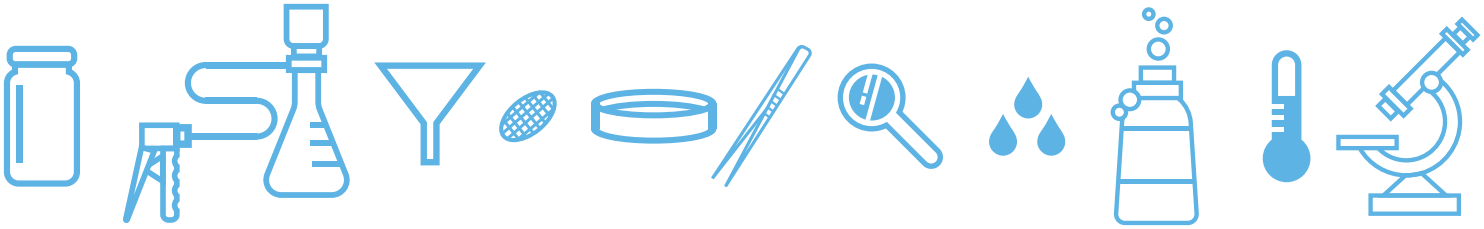
Microfibers in the guts of zooplankton: https://bit.ly/2ZxYD0q

ACTIVITY

NOTE: This activity usually follows lessons on Marine Debris and microplastic. Please see our website for these activities before teaching this lesson.

1. Discussion about microplastics, move into microfibers and engage students about where microfibers might be present (water, air, soil, food…) Explain that we are going to conduct an experiment to investigate what causes more or less shedding of microfibers in the wash.

2. Each learner group should have: jar with lid, cloth, vacuum pump, funnel, filter paper, petri dish, tweezers, magnifying lens, access to hot/cold water, soap, thermometer and microscope access.



3. Explain that they will be conducting an experiment that might cause microfibers to shed from the cloth. Ask the learners, to imagine you are a T-Shirt about to go through the wash, what is going to happen? What variables would cause you to shed? They will be choosing a variable and comparing across groups to see which method produced more microfibers. There will be a control that the groups all agree upon to include, for example: a set amount of water, a set temperature and amount of agitation, no soap.

TOP #1 TIP

If time is limited, test only one variable with 2 variations example: Water high and water low. Have 3 groups test with highwater and 3 groups test with low water.

TOP #2 TIP

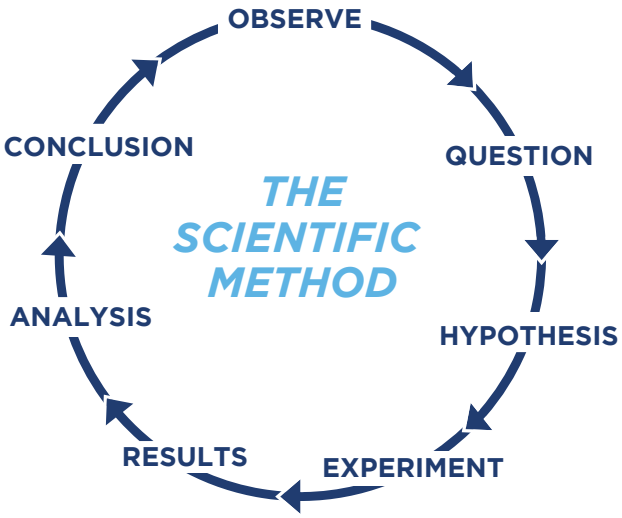
If you have time, establish a baseline by running a control with all groups setting the same variables around the experiment (examples: warm water, ¾ filled jars, moderate agitation speed, etc.). Record observations of the controls, discuss why they might have different results, how to average and share the results (XX fibers/square, n=6).

TOP #3 TIP

With 6 kits, there is a great opportunity to discuss the importance of replicates. When we test the same variable multiple times, it supports statistically valid results. Is it better to test 6 variables 1 time each (n=1)? Or to test 2 variables or variations (n=2) or one variable 3 times (n=3)?

4. Learners should develop a hypothesis about which method will produce more (or less) microfibers, and choose their variable based upon this. They will record their hypothesis on their data sheet.

5. Go over the scientific method and ways to conduct an experiment. Ask students for the stages. Remind them it is a circular system. Conclusions should lead to more observation and questions!



Variables may include:

- amount of water
- water temperature
- length of agitation
- soap

Experiment must include:

- controls
- one testable variable

SET UP THE EXPERIMENTS:

1. Learners will triple rinse jars, funnel and flask before they begin to remove any fibers that may be hiding out in equipment. Let equipment air dry. Then, fill the jar with water to a predetermined line (all groups to same height unless this is their chosen variable), those with temperature as their variable, will use water temp of choice. All learner groups should take the temperature of their water. **Be cautious with hot water, do not make it so hot it cannot be handled.**

Learners who are adding soap will add soap of a set amount. Do not add too much soap here, the jar is not very big. ¼ tsp should be sufficient.

2. Learners who are using time as their variable will need to have access to a timing device. Have learners put lids tightly onto their jars and agitate along to the beat of a song (we suggest Eye of the Tiger or Staying Alive). ***All learners will be agitating their jars for a minimum amount of time. Those using this variable should go longer or shorter.***

3. Once agitation has been completed, examine the jars. Do the learners notice anything about the water? Can they observe any changes? Have them make note of these observations, even if their observation is that there seems to be no difference.

EXPERIMENT SET UP CONTINUED:

4. Place filter paper in the ceramic funnel and place funnel in the glass flask below to catch water.

5. Connect one end of the tubing to the vacuum hand pump and the other end to the glass flask. Learners open their jars and begin to pour the water slowly into the ceramic funnel.

6. Using the vacuum pump ***gently*** pump water through, into the flask. This process will take some time.

7. Once water has been filtered, remove filter paper with tweezers and place into a metal petri dish. There are several ways to count the fibers, we recommend that each team member takes a turn to count, average the number of fibers each member counted.

8. If you have access to microscopes, the filter paper is placed randomly under the microscope and the learners count what is in that view without moving it.

**If done with a hand lens: before the filtering, a 2cm should be drawn on the filter paper in pencil. The students should count the fibers in the grid.*

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9. Discuss their findings. Were they surprised with the results?

DISCUSSION:

- Which process led to the shedding of more microfibers?
- Which process led to the least amount?
- Was your hypothesis correct?
- If incorrect,why do you think so or do you have a follow-up question that you could test?
- What does this signify for our washing machines?
- How can we better wash our clothes, if we want to limit our microfiber shedding?
- What are some alternative solutions we might consider when confronting this problem?
- Why is microfiber pollution a problem?
- When thinking about upstream solutions for microfiber pollution, what are some of the advantages/disadvantages or barriers of redesign and innovative solutions?

10. Encourage students to think of re-designs for the experiment. How can we make it more like real life?

EXTENSIONS:

Make the lesson suited for younger audience:

Learners can use this lesson as an introduction to the scientific method and how to conduct an experiment.

Have learners use only gravity-fed filtering options (make this a longer unit, so gravity has time to work!).

The educator can model the experiment, allowing children to help set design parameters. Or use non-breakable containers and tools.

Make the lesson suited for an older audience:

Present learners with the problem, yet do not give them the experiment ready to go, instead ask them to develop an experiment on their own.

OR - have each group make their own control and variable.
Exploring data from articles or researching articles on this topic.

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National Marine Sanctuary Foundation

NOAA

rozalia project

4. Place filter paper in the ceramic funnel and place funnel in the glass flask below to catch water.