

# Marine Debris-Fishing for Microplastics in Your Home Instructor Manual

A teaching and learning exercise for students studying environmental topics.

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This handout includes materials, tips, and information needed to complete the “Fishing for Microplastics in Your Home” activity. This exercise is intended to be used in introductory science courses to apply the scientific method. The laboratory is a simple gravimetric analysis of an everyday product that students can use to quantify the potentially growing problem of microplastics in the ocean.

## Equipment:

The equipment list below is for one set-up. The number of students/group will depend on the number of set-ups you have. Groups of 2-3 are ideal, but have been successfully completed with 5 students per group. If supplies are limited, this activity can be completed as a demonstration.

Crest Complete-Day	Crest Complete-Night	2 200-mL beakers
Sharpie	labeling Tape	2 retort stands
2 rings w/clamp	2 glass funnels (122 mm diameter)	2 pieces of rubber tubing ~50-mm long
stir bar	hot plate	500-mL beaker
glass stir rod	squirt bottle with DI water	thermal-resistant glove
drying oven (optional)	mass balance	

You will find from the pre-lab, that a number of skin-care products and shampoos contain polyethylene in their ingredient list. To harvest these microplastics, one needs to use hot acetone to melt the waxes surrounding the plastics. Toothpaste was selected for this activity, because hot water can simply be used to remove the plastics from the material.

## Pre-lab:

### Introduction:

To begin this activity, the instructor will need to introduce the plastics problem to the students. Information to discuss will include the properties of plastics, plastic’s ability to remain in the ocean environment, and the growing problem of the plastics in the environment. It is easier to begin the discussion with the very visual macroplastics problem.

### Important Points:

1. Plastics are manmade.
2. Plastics were created to be nonreactive, have low-melting points, and low-densities.

3. Plastics are found in water, sediment, and along beaches of the ocean.
4. Plastics are easily recognized.
5. Plastics are harming macroorganisms through blockage, false-cessation, and POSSIBLE pollutant transference adsorbed onto the plastic surface.

After the introduction, challenge the students to go through their personal care products at home and look for polyethylene in their ingredient list. Most drug store websites, such as Walgreens or drugstore.com, websites will include ingredient lists for their products. If you click on the product, there should be an ingredients list. Here are links for Crest Pro-Health ingredients:

<http://www.walgreens.com/store/c/crest-pro-health-whitening-fluoride-toothpaste/ID=prod4267182-product>

<http://www.drugstore.com/crest-pro-health-whitening-fluoride-anticavity-toothpaste-fresh-clean-mint/qxp196886>

The ingredient list is on a tab on near the bottom left of the page.

#### **Lab:**

Have students create the list of products on the board. Have them group the products by type then by product, and then by manufacturer. Have them create charts illustrating each group.

#### **Group Discussion:**

1. Which type of product with polyethylene was most common in this class' household? Why?
2. Which product with polyethylene was most common in this class' household? Why?
3. How many found no polyethylene in their household? What alternative products do you use beside the common ones recognized above?

Be sure to have the students record this information and notes of the discussion. This information will be used in their final report.

#### **Future Exploration (optional):**

Each of these questions can be further researched after the completion of the laboratory. These can be presented in poster or oral form in groups or as a research paper.

1. What harm is plastic to the ocean environment?
2. What are the pathways of plastics into the ocean environment?
3. How long do plastics remain in the ocean environment?

4. What are alternative products one could use instead of the one(s) discovered?
5. How could one make the public aware of the plastics in their personal care products?

# Marine Debris-Fishing for Microplastics in Your Home

**Introduction:** This lab will teach you how to quantify the amount of microplastics in a consumer product in order to predict environmental implications of continued use of these products.

## **Objectives:**

The student will use a global environmental topic to apply scientific skills to include research, investigation, quantification, and modeling/predication.

The student will use the scientific method to answer questions concerning a global environmental topic.

The student will learn laboratory methods to apply gravimetric analyses for materials being explored.

The student will present their data both in written-and oral-format in order to communicate results.

The students will apply the concept of sustainability through group investigations of human behaviors that have unintended consequences to the environment.

## **Specifically:**

The student will be able to define the problems associated with microplastics in the ocean.

The student will be able to uncover factors causing the environmental problem and relevant concepts to perform an analysis of the problem.

The student will be able to define the systems that dictate the presence of microplastics in the ocean.

Students will demonstrate their understanding through completion of homework assignments, classroom discussions, laboratory activities, and formal reports.

## **Pre-lab: This must be completed before you come to lab.**

Go through your home and read the ingredients label of all of your personal care products. If polyethylene is listed in the ingredients write down the type of personal care product, name of the product, and manufacturer. Note: you are looking for polyethylene with a comma following it. You may find polyethylene or propylene glycol, which may not have solid plastic in the matrix. If your personal care

product does not have an ingredient list printed on the tube/bottle, you can look up the ingredients on any online drugstore.

Fill in the table with the following information: type of product, name of product, name of manufacturer

Type of Personal Care Product	Name of Product	Manufacturer

**Pre-lab Questions: This must be completed before you come to lab.**

1. How many products did you find in your home with polyethylene listed?
2. What size are the plastic bits found in the personal care product?
3. Can you think of an alternative product you could use instead of the one(s) you found? Will you consider using an alternative after this product is gone?

**Materials:**

Crest Complete-Day	Crest Complete-Night	2 200-mL beakers
Sharpie	labeling Tape	2 retort stands
2 rings w/clamp	2 glass funnels (122 mm diameter)	2 pieces of rubber tubing ~50-mm long
stir bar	hot plate	500-mL beaker
glass stir rod	squirt bottle with DI water	thermal-resistant glove
drying oven (optional)	2 150-mL beakers	mass balance

**Lab Procedure:**

1. Measure the mass of a tube of toothpaste and record the value.

Mass of Tube 1: \_\_\_\_\_ Mass of Tube 2: \_\_\_\_\_

2. Measure the mass of a labeled, empty 200-mL beaker and record the value.

Mass of Beaker 1: \_\_\_\_\_ Mass of Beaker 2: \_\_\_\_\_

3. Empty the complete contents of the tube of toothpaste into the beaker. You may have to cut the tube to ensure the entire product gets into the beaker. Rinse tube with warm water.

4. Measure the mass of all of the pieces of the emptied tube and record the value. Subtract the mass of the tube from the mass of the filled tube to determine the mass of the toothpaste.

Mass of Empty Tube 1: \_\_\_\_\_ Mass of Empty Tube 2: \_\_\_\_\_

Mass of Toothpaste Tube 1: \_\_\_\_\_ Mass of Toothpaste Tube 2: \_\_\_\_\_

5. Describe the toothpaste in detail. Use 4 of your 5 senses. Use your sense of smell to predict how the product tastes. **DO NOT TASTE THE TOOTHPASTE!!!!**

Description of Toothpaste 1: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Description of Toothpaste 2: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6. Pour approximately 150-mL of hot water over the beaker contents.

7. Stir the solution with a glass stir bar till the all of the toothpaste has dissolved.

8. Carefully pour the contents in the beaker into the glass funnel supported by the o-ring on the retort stand. Note: the rubber tubing is at the bottom of the funnel and is clamped by the binder clip to impede flow.

9. Leave untouched for approximately 20 minutes.

10. Repeat steps 1-9 for second tube of toothpaste.

11. After 20 minutes, pinch the rubber tubing with two fingers above the binder clip and carefully remove the binder clip.

12. Drain the bottom portion of the solution into a 500-mL beaker. If you accidentally drain too much, pour contents into funnel to let settle for 20 more minutes.

14. Drain the remaining floating material into the labeled 200-mL beaker.

15. Let dry in a drying oven at 75°C overnight or on a laboratory bench for several days till dryness.

16. Repeat steps 11-15 with second prepared solution.

17. After beakers with solutions have dried, measure the mass of the beaker and dried material and record the value. Subtract the mass of the beaker from the mass of the beaker + dried material to determine the mass of the plastics.

Mass of Beaker 1+ Dried Material: \_\_\_\_\_ Mass of Beaker 2 + Dried Material: \_\_\_\_\_

Mass of Dried Material 1: \_\_\_\_\_ Mass of Dried Material 2: \_\_\_\_\_

### **Post Lab Questions:**

Plastic found in personal care products are so small that once we have used the product, it essentially travels straight into the ocean environment. Wastewater treatment plants cannot filter out this size-fraction of material during these treatment processes.

1. What were the masses of plastics for each tube of toothpaste? Determine the concentration of plastics in the product. To do so, divide the mass of plastics by the mass of the toothpaste. This will give you to portion of plastics to toothpaste.
2. Why were the two products used? Can this be related to what one would observe in the environment?
3. Approximate the amount of toothpaste an individual uses each day. Determine the fraction of plastics for the daily use. Repeat this for weekly use, monthly use, and yearly use.
4. How many people live in your city? Multiply this by your previous calculations. Do the same for the population of your state.
5. How can you compare your city's amount of plastics to an everyday object? What was your reaction to this value?
6. How much microplastic could potentially be release in 3, 5, and 10 years? Compare these amounts to an everyday object.
7. The amount of plastics in the ocean environment is steadily increasing with time. What ways can we sustainably reduce the amount of plastics present in the ocean environment?

### **Lab Report:**

Create a formal lab report which includes an introduction, methods, data, discussion, and conclusion.

Data should be represented in tables. Be sure to include the data collected in the pre-lab. The discussion should include answers the post lab questions listed above. The conclusion should include the overall message of this lab, and also ideals for future exploration.