

3.Problem Identification:

What's hidden in our laundry water?

CIIMAR TEAM (Portugal)

Topic: Natural Sciences and Biology

Description: This scenario is suitable for students aged between 12-18 years. The students have to reflect about the one of the sources of microplastics to the environment

Aims: Raise awareness to the problem of microplastics, in particular polyester fibres, and the consequences they have to the marine environment.

Outcome: Raise awareness of the need to reduce the production and consumption of plastics, as well as to warn about the need to change our daily activities that negatively affect the marine environment.

| Title | Procedure | Time |
|---------------------|--|------|
| Presentation | The topic is introduced to the students | |
| Workgroup | In groups students carried out the lab activities. Each student group should have their own sample | |
| Discussion | After the activities the student fill in the experimental log, registering data obtained and answering the questions | |
| Presentation | Students present their work to classmates and discuss the differences among samples | |

Activities:



WHAT'S HIDDEN IN OUR LAUNDRY WATER?

Background information

Multiple daily human activities carried on inland and in coastal zones directly and indirectly affect the marine ecosystem. According to the United Nations, about 80% of all litter at sea comes from land, with plastic waste as the most representative fraction (60-95%). Besides the 8 million tons of plastic thrown into the ocean every year, more and more personal hygiene products have microplastics (a facial cleanser can have about 330 thousand of microplastics) and many pieces of clothing have polyester fibres in their composition. It has been estimated that about 1,900 plastic microfibers are released from a single synthetic cloth every time it is washed in a laundry machine. Due to its small size, microfibers are not retained in the washing machine filter and end up in the marine environment. It has also been estimated that there are about 4 billion plastic microfibers per km² of ocean floor.

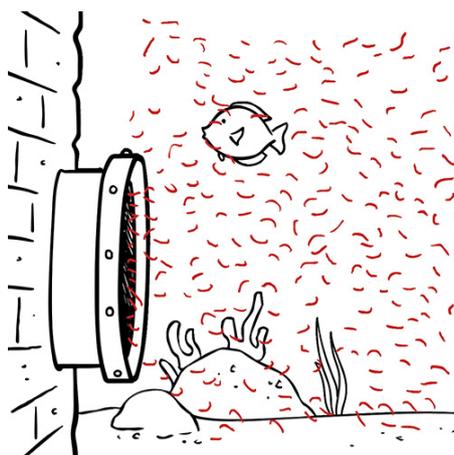


Figure 1: Polyester fibres (plastic) being release in the marine environment.

Source: <http://storyofstuff.org/blog/microfibers-are-microplastics-1/>

Target Audience

Curricular Areas: Natural Sciences and Biology

Age group: 12-18

Aims

The purpose of this activity is to raise awareness to the problem of microplastics, in particular polyester fibres, and the consequences they have to the marine environment. This activity aims to raise awareness of the need to reduce the production and consumption of plastics, as well as to warn about the need to change our daily activities that negatively affect the marine environment. This activity is related with The Ocean Literacy Principles, namely Principle 6 –The Ocean and Humans are inextricably interconnected³.

Material

- 1.5L bottle
- Large bucket
- Funnel
- 100% polyester clothing
- Filtration glassware (i.e. Büchner flask, filtration glass, clamping device...)
- Vacuum pump with hose
- Six ca. 1.2µm membrane filters
- Stereomicroscope
- Petri dishes
- Tweezers
- Dissection needle
- Lighter
- Light microscope

³ <http://oceanliteracy.wp2.coexploration.org/>



Procedure

1. To perform this experiment it will be necessary to collect the water from the first wash of a washing machine;
2. Make sure the water outlet hose of the washing machine is in a visible and safe place (for example, inside a bucket);
3. Select 100 % polyester clothes (confirm on the label of each piece of clothing). Give preference to clothes with vibrant colours to facilitate the observation of microfibers with the magnifying glass;
4. Wash the polyester clothes the washing machine using the “economical” program. Do not use any type of detergent or soap;
5. Pay attention to the water outlet of the washing machine and, using a funnel, connect the hose to the mouth of the plastic bottle (do this in a bucket). After collecting 1.5L of water, the hose can be returned to the usual location;
6. Do not store water collected for many days (try to do the laundry the day before the experiment);
7. Before starting the filtration, close the bottle and shake it vigorously 3 times for about 5 seconds (repeat the process when necessary, the microfibers can stick to the wall of the plastic bottle);
8. Prepare the filtration system (vacuum pump + filtration glassware + clamping device) and fit the filter (for a more economical, and easy to find, option you can use round-cut coffee paper filters that fit the filter cup);
9. Turn on the vacuum pump and gradually pour the water from the bottle. Change filters whenever you feel you need;
10. At the end of each filtration, transfer the filter to a Petri dish with the tweezers and observe with the stereomicroscope;
11. The microfibers present in the filter may also be separated into categories (colours, sizes, texture) in order to facilitate their counting and logging;
12. Try to distinguish synthetic from cotton microfibers with the help of the light microscope. Polyester fibres are smooth tubes, usually translucent in their interior, with very well defined walls. Cotton fibres are flat, usually twisted, their interior may contain pigmentation and the walls have many imperfections and folds (Fig. 2 and 3);
13. To confirm you are observing a synthetic microfiber you may also do the “hot needle test”, with the help of the stereomicroscope and of an adult to manipulate the lighter or another



heat source. Heat the tip of a dissection needle with a lighter (or other heat source) and place the hot needle near the fibre under analysis. If the fibre quickly curls or melts on the needle, showing the behaviour of a burning plastic, it can be considered to be a plastic rather than a cotton microfiber.

Suggestion: The same procedure can also be carried out with 100% cotton clothing thus allowing making comparisons between microfibers of natural fabrics and synthetic fabrics.

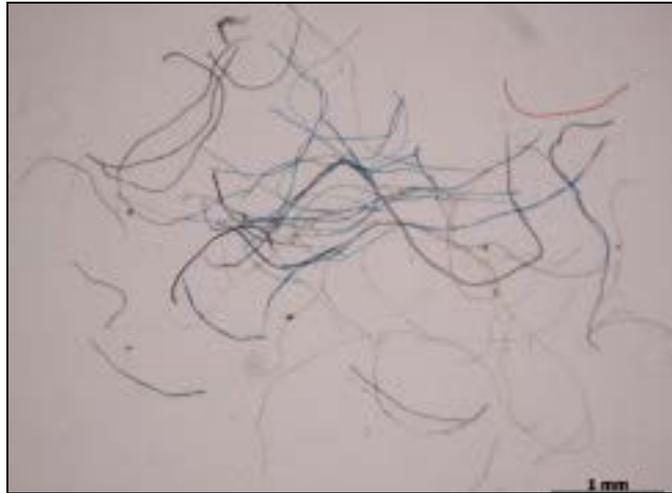


Figure 2: polyester fibres observed under the light microscope.

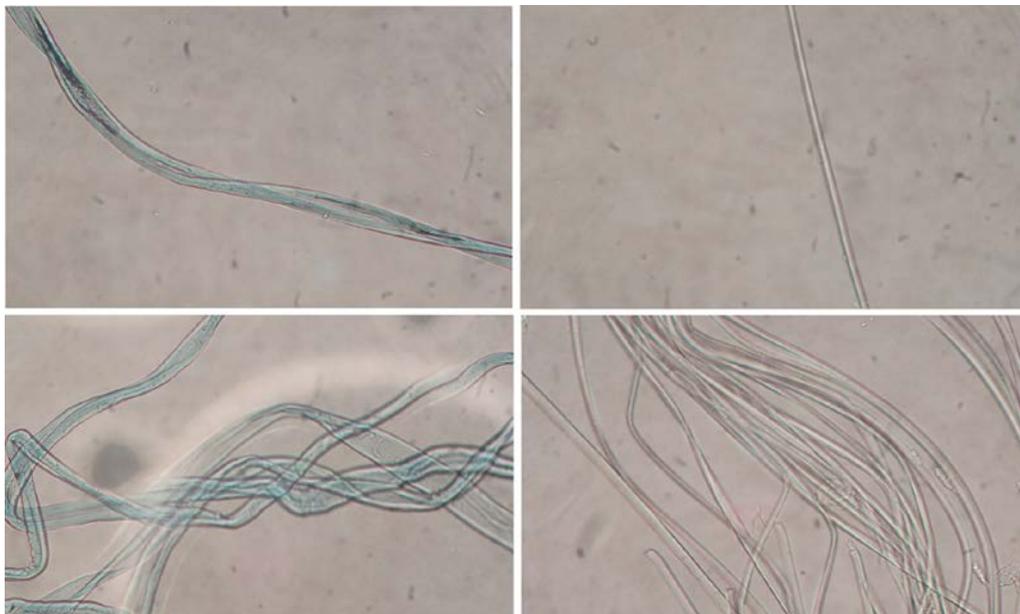
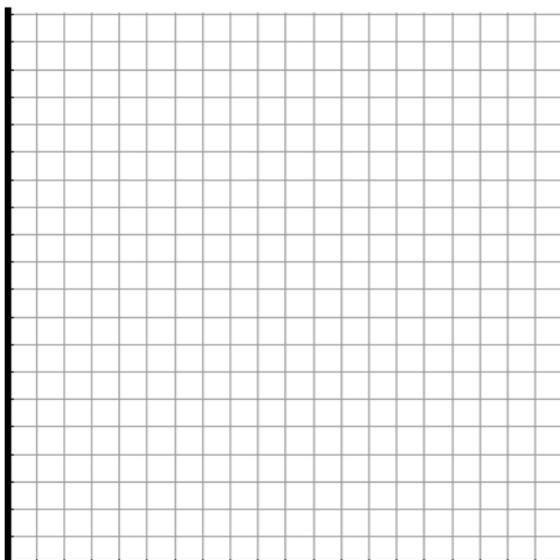
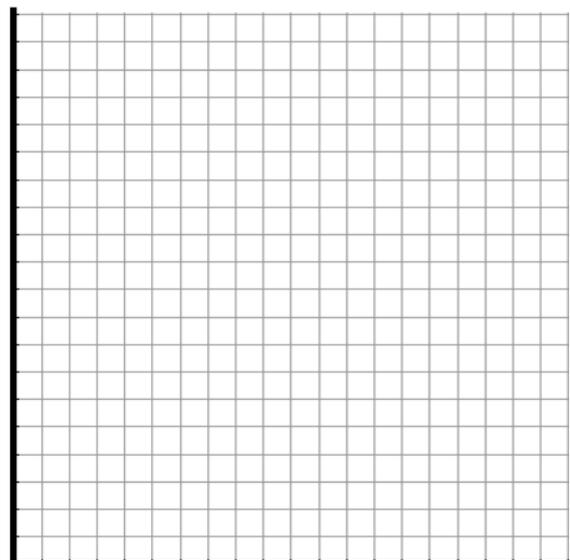


Figure 3: Cotton (left) and polyester (right) microfibers observed under the light microscope.

Table 1:

| | Number of Microfibers | |
|--------------|-----------------------|--------|
| | Polyester | Cotton |
| Colour 1: | | |
| Colour 2: | | |
| Colour 3: | | |
| Colour 4: | | |
| Colour 5: | | |
| Colour 6: | | |
| Total (in %) | | |

5. In the axes system below draw graphs for the number of polyester microfibers of each colour counted in the water sample (Figure 1) and for the total relative frequency (in %) of polyester and cotton microfibers found (Figure 2). Write the captions for the X and Y axes and the graphs you have drawn.


Figure 1.

Figure 2.

6. What is the difference between a polyester and a cotton microfiber?

7. What type of clothing releases more fibres per litter of water?

8. Choose five classmates and write down on the table the material with which each T-shirt is made of (example: polyester, cotton, nylon ...). Write down the table caption.

Table 2:

| Class Colleague | T-shirt Material |
|-----------------|------------------|
| Colleague 1 | |
| Colleague 2 | |
| Colleague 3 | |
| Colleague 4 | |
| Colleague 5 | |

9. What conclusions can you draw from Table 2 regarding the use of plastic in our clothing?

10. Right now, are you wearing any clothes or have any school supplies that do not contain plastic? If yes, indicate which.

11. What measures would you propose to be taken to prevent water contamination with polyester microfibers?

12. What can you do to reduce the use of plastic in your daily life? Give two examples.



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