

Marine Waste

Before you Begin

Marine debris or marine litter, is human-created waste that has deliberately or accidentally been released in a lake, sea, ocean or waterway. Marine debris is anything that does not belong in the ocean, that could range from abandoned ships to tiny plastic fibers from clothes. Floating oceanic debris tends to accumulate at the center of gyres (a large system of circulating ocean currents) and on coastlines. Waste is today also being deliberately dumped into the oceans and this deliberate disposal of wastes at sea is called ocean dumping.

Plastics are a major source of global marine pollution. Once plastic particles reach the marine environment, wind and global ocean currents can spread them around the world. As a result, plastics are dispersed across all oceans, and can be found in remote locations such as the Arctic, Southern and deep oceans. Ocean plastic pollution is an alarming issue due to its persistence, complexity, steady growth and the pervasive impacts it has on all aspects of ecosystems. The problem requires holistic environmental remediation solutions at a global scale.

Ocean plastic pollution has received increased attention in recent years. Including in the recent policies and programmes of the United Nations Organisations.

Sources of marine plastic

According to currently available estimate, 80 percent of marine plastic pollution originates from land-based sources with the remainder coming from ocean-based sources.

Land based sources	Ocean based sources
1. Illegal dumping and inadequate waste management 2. Industrial activity 3. Insufficiently filtered wastewater 4. Coastal littering 5. Discharge of stormwater 6. Combined sewer overflows 7. Natural disasters	1. Fishing 2. Shipping 3. Offshore oil and gas platforms; undersea explorations

Source: (https://www.imperial.ac.uk/media/imperial-college/grantham-institute/public/publications/briefing-papers/The-ocean-plastic-pollution-challenge-Grantham-BP-19_web.pdf)

Microplastics

Plastic marine debris less than 5 mm is classified as microplastics. Microplastics come from a variety of sources, including from larger plastic debris that degrades into smaller and smaller pieces.

In addition, microbeads, a type of microplastic, are very tiny pieces of manufactured polyethylene plastic that are added as exfoliants to health and beauty products, such as some cleansers and toothpastes. These tiny particles easily pass through water filtration systems and end up in the ocean and lakes, posing a potential threat to aquatic life.

Microbeads are not a recent problem. According to the United Nations Environment Programme, plastic microbeads first appeared in personal care products about fifty years ago, with plastics increasingly replacing natural ingredients. As recently as 2012, this issue was still relatively unknown, with an abundance of products containing plastic microbeads available in the market and lack of awareness on the part of consumers.

Many countries have started addressing this problem.

On December 28, 2015, President Obama signed the Microbead-Free Waters Act of 2015, banning plastic microbeads in cosmetics and personal care products.

Source: <https://oceanservice.noaa.gov/facts/microplastics.html>

Micro Solutions to Microplastics



INTRODUCTION

The lesson encourages investigation into the problem posed by microbeads and microplastics. The learning process includes reading and researching information pertaining to the topic, classroom interactions, group work, investigating awareness about the topic through personal interviews; analysing responses and communicating about the topic through an article.

Objectives:

Students will be able to

- explain the different problems associated with microbeads.
- analyze the problems associated with microbeads.
- list composition of microbeads in different products.
- interview and identify beliefs/perspectives on the problem of plastic waste.
- research the internet to find out about rules, education drives/campaigns in place to tackle the microbeads problem in different countries.
- prepare an article on the issue highlighting the problem, perspectives and solutions (laws, educational drives/campaigns etc.) to create awareness and promote action on micro-beads.

YRE steps: Investigate, Report

Curriculum Linkage: Science/ Environmental Studies/Social Science



13-16
Years

Time required/ Duration:

- **Classroom Session 1:** 45 minutes to introduce the concept of microbeads, class based activity to list different products and their microbead constituents.
- **Classroom Session 2:** 45 minutes classroom based reading and discussion to understand the extent of the problem posed by microbeads.
- **Group Assignment 1:** 2-3 days provided for home based assignments to undertake internet based search and personal interviews.
- **Classroom Session 3:** 45 minutes classroom based interaction and analysis time.
- **Group Assignment 2:** Seven days provided for home based assignments for compiling and disseminating student articles.





Resources Required:

- Different types of personal care products including face wash, toothpaste, shaving creams, etc; some of these might be containing microbeads and others may not be
- Resource 1 “How your clothes are poisoning our oceans and food supply” - <https://www.theguardian.com/environment/2016/jun/20/microfibers-plastic-pollution-oceans-patagonia-synthetic-clothes-microbeads> Article from the International Edition of The Gaurdian. Based on the access to the internet, teachers can choose to view the article online or keeping sufficient copies to handout 1 article each to each of the groups. The teacher might have to provide 20 min reading time for the article
- Resource sheet 2 Did you know? - (going through the sheet and listed links - 20 min). The links mentioned in this document should be interesting reading material for students as part of the group assignments
- Resource 3: President Obama signs Microbead-Free Waters Act of 2015
- Resource 4: Investigate microbeads table
- Resource 5: Personal interview questionnaire
- Internet and Laptop
- Projector and screen (if laptops are not available)
- Resource 6: List of microplastic/micorbeads commonly used

Activity

Classroom session 1

- Introduce students to the concept of microbeads and microplastics and mention the different products in the market which contain these.
- Screen the video from the Story of Stuff Project <https://storyofstuff.org/plastic-microbeads-ban-the-bead/> (2.11 minutes duration). The video illustrates the problem posed by microbeads.
- Divide the class into groups of 3-4 students.
- Distribute to each group some of the products (personal care products including toothpaste, body wash, etc) she has got to the class.
- With the help of a magnifying glass ask the groups to search/look for the mention of different constituents representing microbeads in the list of ingredients mentioned on the packaging of these products. Each group should list these.
- Ask the students should to list these products and the constituents on the Eco-Schools bulletin board to create awareness.

Classroom session 2

- Students continue to work in groups constituted during the previous class.
- Teachers should guide the students to read the article “How your clothes are poisoning our oceans and food supply” from the link listed in Resource 1 and identify the ill effects of microplastics. (20 minutes should be set aside for groups to read this article).
- Further the teacher should get the students to read the Did you know? and the associated references for understanding different products containing different types of microbeads. (20 minutes for groups).
- Teacher discussion should help students consolidate the extent of the problem posed by microbeads.

Group Assignment

1

As part of this groups take up two major types of assignments (2-3 days time need to be provided to student groups to accomplish these tasks):

1. Internet based search:

- Internet based search to investigate rules and educational programmes that exist with regards to microbeads, minimum one country should be selected by a group.
- Students should then tabulate the information in the Investigate microbead table (Resource 4).

2. Conducting Personal interviews:

- Each student of each group needs to conduct one personal interview. Each group will thereby get 3-4 responses.
- The interview time with each respondent should be restricted to 20 minutes.
- The interview is conducted to understand the respondent's perspectives with regards to microbeads and microfibers.

Classroom session

3

- Provide student groups 45 minutes of classroom interaction to discuss and analyse their finding prior to getting into the reporting process.

Group Assignment

2

As part of this groups take up the assignment of reporting in the form an article (five hours over a week should be provided to student groups to accomplish this task):

- Students should continue to work in groups and report one article per group.
- The articles should be based on the analysis of their findings based on interview responses, classroom interaction and internet search.
- Students articles should present the problem, people perspective and solutions (laws, education drives, others) to create awareness and promote action on microbeads.
- Teachers should get student groups to share their articles to create awareness through a local newspaper, or share the same on the school social media page or share the same during an assembly in the school, etc.

- For article: Refer Lesson Plan 1 from chapter “Learning to be an Environmental Journalist”

Evaluation

A quick check in the form of question and answers with students prior to and after the activity to understand what they know about microbeads and how to look for them in different products.

Resources

Resource 3

US has a ban against microbeads, investigate the internet to search if other countries have introduced laws/ legislations/ others in this regard.

President Obama Signs *Microbead-Free Waters Act of 2015*

December 28, 2015

Washington D.C. – A federal law was passed and signed by President Obama that bans the production and sale of personal care products with plastic microbeads. Some personal care products, such as toothpaste and face wash, have plastic microbeads that can go down the drain and into the ocean. Scientists are not sure how microbeads affect the ocean environment. To stop more plastic from entering the ocean, congress decided to ban personal care products with microbeads, starting in 2017. Nobody will be allowed to make or sell personal care products with microbeads anywhere in the United States.

Resource 4

Country	Existing Laws pertaining to microbeads	Existing awareness programmes pertaining to microbeads

Resource 5

Personal interview questionnaire

1. Have you ever heard the term microbeads?

Yes ☐ No ☐

2. What is a microbead?

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3. Why are they being used?

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4. What types of products contain microbeads?

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5. Do you look for microbead labelling when you buy a personal care or other product?

Yes ☐ No ☐

6. Do you know of any environmental risks associated with microbeads?

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7. Do you know of any health risks associated with microbeads?

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8. Would you prefer to buy a product which contains microbeads?

Yes ☐ No ☐

9. Would you avoid a product which contains microbeads?

Yes ☐

No ☐

10. Will you tell others about the problems associated with microbeads?

Yes ☐

No ☐

11. What other personal steps would you to take to help resolve this problem?

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Resource 6

List of synthetic polymers which may occur as synthetic microparticles in a product or process

Sl. No.	Prefix	Repeating unit	Abbreviation	Application as primary synthetic microparticle	Possible function
1	Poly	1,4-cis-Isoprene	-	Rubber	Natural rubber
2	Poly	2-hydroxyethyl methacrylate	HEMA	Paint, Drug	Drug delivery
3	Poly	2-hydroxypropyl methacrylate	HPMA	Paint, Drug	Drug delivery
4	Poly	Acrylate	PA	Cosmetics	Viscosity Controlling
5	Poly	Acrylonitrile	-	Synthetic rubber	Rubber
6	Poly	Acrylonitrile butadiene styrene	ABS	Drugs	Polymer granules for making of products
7	Poly	Actide	PLA	Drugs	Drug delivery
8	Poly	Alkyd resins	-	Paint	Paint binder
9	Poly	Alkyl stearate/vinyl acetate copolymers	-	Cosmetics	Film formation, hair fixative
10	Poly	Buthylene/Ethylene/Styrene copolymers	-	Cosmetics	Viscosity Controlling
11	Poly	Butyl acrylate	PBA	Drugs	Drug delivery
12	Poly	Butyl methacrylate	PMMA	Drugs	Sorbent for delivery of active ingredients
13	Poly	Butylene terephthalate	PBT	Cosmetics	Film formation, hair fixative
14	Poly	Caprolactam (Nylon 6)	-	Cosmetics	Bulking agent, viscosity controlling
15	Poly	Cellulose acetate	-	Cosmetics, paints, glue	Gelling and thickening agent
16	Poly	Cellulose nitrate	-	Cosmetics, paints, glue	Gelling and thickening agent
17	Poly	Chloroprene	CR	Rubber	
18	Poly	Dimethylsiloxane (silicone)	PDMS	Cosmetics, food bulking agent in medical applications	Film formation, viscosity controlling, bulking agent
19	Poly	Ethyleneimine	PEI	Drugs, cosmetics	Bulking agent, drug delivery
20	Poly	Ethylene -glycol	PEG	Drugs	Drugs delivery, semi - manufacture
21	Poly	Elastine -like polypeptide	ELP	Drugs	Drugs delivery
22	Poly	Epoxy resins	-	Paint, glue	
23	Poly	Ethyl acrylate	-	Paint, textiles, pharmaceuticals	
24	Poly	Ethyl methacrylate	-	Paint, glue	
25	Poly	Ethylene	PE	Paint, cleaning, tracing, leaving voids after burning	

26	Poly	Ethylene methylacrylate copolymer	-	Cosmetics	Film formation
27	Poly	Ethylene terephthalate	PET	Divers, cosmetics	Adhesive, film formation, hair fixation, viscosity controlling, aesthetic agent
28	Poly	Ethylene vinyl acetate	EVA	Glue	Adhesive
29	Poly	Ethylene/acrylate copolymer		Cosmetics	Viscosity agent
30	Poly	Ethylene/Propylene/ Styrene copolymers	-	Cosmetics	Viscosity agent
31	Poly	ϵ -caprolactone	-	Medical	Drug Delivery
32	Poly	Formaldehyde (oxymethylene)			
33	Poly	Glicolic acid	-		
34	Poly	Isobornyl acrylate	-		
35	Poly	Isobornyl methacrylate	-		
36	Poly	Isobutyl methacrylate			
37	Poly	Isobutylene			
38	Poly	Isoprene			
39	Poly	Lactic acid	PLA	Medical	Drug Delivery/ filling agent
40	Poly	Lauroctam (Nylon 12 and Amide -12)	-	Cosmetics	Bulking, viscosity controlling, opacifying
41	Poly	Lauryl methacrylate			
42	Poly	Methacrylated hyaluronic acid	MA-HA	Drugs	Drug Delivery
43	Poly	Methacrylonitrile	MAN		
44	Poly	Methyl acrylate	OMA	Drugs	Drug Delivery
45	Poly	Methyl methacrylate	-		
46	Poly	n- Hexyl methacrylate	-	Paint, glue	
47	Poly	N- isopropylacrylamide	NIPAM	Drugs	Drug Delivery
48	Poly	Octyl methacrylate			
49	Poly	Pentaerythrityl terephthalate	-	Cosmetics	Film formation
50	Poly	Propyl acrylate	-		
51	Poly	Propyl methacrylate			
52	Poly	Propylene	PP	Macro plastic products, cosmetics	Polymer granules for making of products, Bulking agent, viscosity increasing agent
53	Poly	Propylene oxide		Macro plastic products,	
54	Poly	Propylene terephthalate	PPT	Diverse, Cosmetics	Emulsion Stabilising, Skin conditioning
55	Poly	Stearyl methacrylate	-	Coating textiles	
56	Poly	Styrene	PS	Macro plastic products, cosmetics, tracers	Film formation, polymer gradients
57	Poly	Styrene/ Acrylate copolymer		Cosmetics	Aesthetic coloured microspheres
58	Poly	Tetrafluoroethylene (Teflon)	PTFE	Lubricating agent in drilling fluid, cosmetics, bulking agent in medical applications	Bulking agent, slip modifier, binding agent, skin conditioner, lubrication, bulking agent in medical applications

59	Poly	Tetrahydrofuran	THF		Further processing chemicals
60	Poly	Trimethylsiloxysilicate (Silicone resin)	TMSS	Cosmetics	Film formation
61	Poly	Urethane	PUR	Cosmetics, paints, macro plastic products	Film formation, polymer granules for making of products
62	Poly	Vinyl acetate	PVA	Paints, coatings, textiles	Used for adhesivedition
63	Poly	Vinyl alcohol	PVOH	Paint	Stabiliser
64	Poly	Vinyl chloride	PVC	Macro plastic products	polymer granules for making of products
65	Poly	Vinylidene chloride	PVDC	Coating, cleaning	Used as water based coating
66	Poly	Vinylpolypyrrolidon	PVPP	Clarifier	Clarifying of beverages e.g. beer, wine, fruit juices
67	Poly	Ethylene vinyl alcohol opolymer	Tegress	Medical bulking agent	

Find out which of the above has a natural alternative available.

Micro Solutions to Microplastics- Reporting



INTRODUCTION

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Objective:

Students will be able to

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- list composition of microbeads in different products.
- interview and identify beliefs/perspectives on the problem of plastic waste.
- research the internet to find out about rules, education drives/campaigns in place to tackle the microbeads problem in different countries.
- prepare an article on the issue highlighting the problem, perspectives and solutions (laws, educational drives/campaigns etc.) to create awareness and promote action on micro-beads.

YRE steps: Investigate, Research Solution, Report, Disseminate

Curriculum Linkage: Science/ Environmental Studies/Social Science



15-18
Years

Time required/ Duration:

- **Classroom Session 1:** 45 minutes to introduce the concept of microbeads, class based activity to list different products and their microbead constituents.
- **Classroom Session 2:** 45 minutes classroom based reading and discussion to understand the extent of the problem posed by microbeads.
- **Group Assignment 1:** 2-3 days provided for home based assignments to undertake internet based search and personal interviews.
- **Classroom Session 3:** 45 minutes classroom based interaction and analysis time.
- **Group Assignment 2:** A week days provided for home based assignments for compiling and disseminating student articles.





Resources Required:

- 7-8 different types of personal care products including face wash, toothpaste, shaving creams, etc; some of these might be containing microbeads and others may not be
- Resource 1 “How your clothes are poisoning our oceans and food supply” - <https://www.theguardian.com/environment/2016/jun/20/microfibers-plastic-pollution-oceans-patagonia-synthetic-clothes-microbeads> Article from the International Edition of The Gaurdian. Based on the access to the internet, teachers can choose to view the article online or keeping sufficient copies to handout 1 article each to each of the groups. The teacher might have to provide 20 min reading time for the article
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- Internet and Laptop
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Activity

Classroom session 1

- The teacher should introduce students to the concept of microbeads and microplastics and mention the different products in the market which contain these.
- The teacher should Screen the video from the Story of Stuff Project <https://storyofstuff.org/plastic-microbeads-ban-the-bead/> (2.11 minutes duration). The video illustrates the problem posed by microbeads.
- Teachers should then divide the class into groups of 3-4 students.
- The teacher should distribute to each group some of the products (personal care products including toothpaste, body wash, etc) she has got to the class.
- With the help of a magnifying glass the groups must search for the mention of different constituents representing microbeads in the list of ingredients mentioned on the packaging of these products. Each group should list these.
- Students should list these products and the constituents on the bulletin board to create awareness.

Classroom session 2

- Students continue to work in groups constituted during the previous class.
- Teachers should guide the students to read the article "How your clothes are poisoning our oceans and food supply" from the link listed in Resource 1 and identify the ill effects of microplastics. (20 minutes should be set aside for groups to read this article)
- Further the teacher should get the students to read the Did you know? And the associated references for understanding different products containing different types of microbeads. (20 minutes for groups).
- Teacher discussion should help students consolidate the extent of the problem posed by microbeads.

As part of this groups take up two major types of assignments (2-3 days time need to be provided to student groups to accomplish these tasks):

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Group Assignment

1

1. Internet based search:

- Internet based search to investigate rules and educational programmes that exist with regards to microbeads, minimum one country should be selected by a group.
- Students should then tabulate the information in the Investigate microbead table. (Resource 4)

2. Conducting Personal interviews:

- Each student of each group needs to conduct one personal interview. Each group will thereby get 3-4 responses.
- The interview time with each respondent should be restricted to 20 minutes.
- The interview is conducted to understand the respondent's perspectives with regards to microbeads and microfibers.

Classroom session

3

- Provide student groups 45 minutes of classroom interaction to discuss and analyse their finding prior to getting into the reporting process.

Group Assignment

2

As part of this groups take up the assignment of Reporting in the form an article (A week should be provided to student groups to accomplish this task):

- Students should continue to work in groups and report 1 article per group.
- The articles should be based on the analysis of their findings based on interview responses, classroom interaction and internet search.
- Students articles should present the problem, people perspective and solutions (laws, education drives, others) to create awareness and promote action on microbeads.
- Teachers should get student groups to share their articles to create awareness through a local newspaper, or share the same on the school social media page or share the same during an assembly in the school, etc.

Evaluation

Student articles could be evaluated to see how well they have communicated about the problems associated with microbeads and what are the points they have built in to increase people's awareness about the problems and suggested alternatives to the issue.

References:

1. The Guardian <https://www.theguardian.com/environment/2016/jun/20/microfibers-plastic-pollution-oceans-patagonia-synthetic-clothes-microbeads>
2. Story of Stuff <https://storyofstuff.org/plastic-microbeads-ban-the-bead/>
3. Beat the Microbead - <http://www.beatthemicrobead.org/>
4. <http://web.unep.org/environmentassembly/marine>