

Beach Detective – Microplastics Investigation

Trash to Treasure Class Resource Kit



Preparation

Class Level	Grade 6
Objectives	In this activity kit, students will learn what a microplastic is, what it is made out of, and how to identify and recover microplastics from samples.
Curricular Competencies	<p>Science:</p> <p>Questioning and Predicting</p> <ul style="list-style-type: none">• Demonstrate a sustained curiosity about a scientific topic or problem of personal interest• Make observations in familiar or unfamiliar contexts• Identify questions to answer or problems to solve through scientific inquiry• Make predictions about the findings of their inquiry <p>Planning and Conducting</p> <ul style="list-style-type: none">• Explore and pose questions that lead to investigations• Observe, measure, and record data, using appropriate tools, including digital technologies• Use equipment and materials safely, identifying potential risks <p>Evaluating</p> <ul style="list-style-type: none">• Identify possible sources of error• Suggest improvements to their investigation methods <p>Processing and analyzing data and information</p> <ul style="list-style-type: none">• Experience and interpret the local environment• Construct and use a variety of methods, including tables, graphs, and digital technologies, as appropriate, to represent patterns or relationships in data• Identify patterns and connections in data• Compare data with predictions and develop explanations for result <p>Social Studies:</p> <p>Differentiate between short- and long-term causes, and intended and unintended consequences, of events, decisions, and developments</p>
Background	<p>Students may have previously taken part in the shoreline cleanup part of NS3's "Trash to Treasure" program. In addition, students may also have completed the optional follow-up activity "Fishing for Microplastics".</p> <p>If the class has not participated in NS3's "Trash to Treasure" program, it is recommended that the class take part in a beach/park or school clean-up as an introduction to this activity, however, it is not necessary to complete this lesson.</p> <p>This sign-out activity kit explores how to effectively remove microplastics from beach sand or dirt.</p>

Materials/Equipment	<p>Included in Kit:</p> <p>Day 1</p> <ul style="list-style-type: none"> • One 10x Magnification Microscope • Six prepared microscope slides <ul style="list-style-type: none"> ○ Sand from the Departure Bay Beach (Slide 1) ○ Microplastics from body wash (Slide 2) ○ Microplastic and Sand (Slide 3) • 30 Animal Cards • Microplastics Guessing Game (5 vials labelled A-E) • Products with Microplastics (Sample Kit 1) • Coffee filters • Large sheets of paper (for Placemat Activity) • Eight Crayola markers • Bucket of salt with microplastics • Five small strainers • 30 containers with lids <p>Day 2</p> <ul style="list-style-type: none"> • 6 large buckets • 6 large sieves • 30 tweezers • 6 plastic pipets • 50 white plates • Blank glass slides and slide covers • Microplastics Recovery Jar
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Activity

<p>Day 1 Introduction</p>	<p>To begin this activity, the teacher will need to introduce the plastics problem to the students (if the class has already completed the “Fishing for Microplastics follow-up activity, skip to Part B).</p> <p>Part A</p> <p>Introduction to plastics discussion may include the properties of plastics, plastic’s ability to remain in the ocean environment, and the growing problem of the plastics in the environment. Using visual aids to introduce the plastic problem is often the most impactful method. It should be noted that some images of wildlife affected by plastics can be upsetting to some children.</p> <p>Important Points:</p> <ol style="list-style-type: none"> 1. Plastics are manmade. 2. Plastics are found in water and along beaches. 3. Plastics come in all shapes and sizes and can be mistaken for food. 4. Small plastics less than 5mm in size are called <i>microplastics</i> (5mm is about the diameter of a pencil eraser). <i>Macroplastics</i> are larger than 5mm. 5. Microplastics are harming organisms by creating internal abrasions and blockages in the digestive system, false-cessation (feeling full), and POSSIBLE transfer of pollutants to animals from particles adsorbed (adhered) onto the plastic surface.
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	<p>Part B</p> <p>If the class has participated in a beach/park or school clean-up, ask the class what the largest and smallest sizes of garbage found were. Continue the conversation by asking the class why they think they were unable to collect garbage smaller than a certain size. (Possible answers include: time restriction, difficulty seeing smaller items within a large amount of sand, difficulty identifying what was garbage and what was naturally part of the sand/beach/environment.)</p> <p>If the class has not participated in a clean-up, ask the students for examples of garbage typically seen at the beach and write their answers on the board with a drawing of their approximate size. Continue the conversation by discussing how small their largest example provided is, and why they did not come up with any examples smaller than that size.</p> <p>Show the class an example of a product with microplastics in it (sample 1). Using an ELMO or by simply walking around, show the students on the product label where polyethylene is, and explain that this ingredient is what plastic is made of. Take a single coffee filter and squirt the product once or twice into the middle of the coffee filter. Pour water over the sample slowly enough for the water/soap mixture to filter through without going over the sides. Eventually small, white microplastic beads will appear. Collect these beads into your hand or a small container and show the class what you have collected. Discuss the size and appearance, and how it compares to sand and dirt.</p> <p>It is important for students to realize that not all plastic is in the shape of a microbead. Using the board (or on an ELMO or projector etc), copy or display the diagram on page __ explaining the three main types of microplastic. Some additional information to include:</p> <ul style="list-style-type: none"> • Every time an item made of polyester is washed, it can shed up to 2000 pieces of microplastic into the water system • All pieces of plastic will eventually break down, creating microplastic fragments. • Plastic nurdles are a type of pellet that are a major contributor to ocean debris. One shoreline microplastic study found that nurdles were the most common beach contaminant, comprising roughly 98% of the debris collected. Nurdles are commonly used in several household and commercial products including dog toys, beanbag chairs and ‘exfoliating microbeads’ in personal care products.
Warm-Up Activity	<p>Split the class so that the students are in groups of 5-6. One suggested way of grouping the students is to hand out an <u>animal card</u> (included in kit) to each student, and to have each animal type form a group (all crabs in one group, all fish in another group). Once all groups are together, hand out <u>Beach Detectives: Microplastic Investigation Student Package</u> to each student, and begin to explain each station.</p>

	<p>Stations:</p> <p>Microscope: Set up the microscope provided with one sand sample (Slide 1), one microplastic sample (Slide 2) and one sand and microplastic sample (Slide 3). If students have previous experience using microscopes let them set up and focus the samples. If the students do not have experience using microscopes, set up the first sample so it is in focus. Have each student take a turn looking at the samples, then have the student sketch out what they saw and label it in their booklet (Page 1).</p> <p>Placemat: Give each group member a different coloured marker. Ask each student to write two unique ideas on the sheet of paper (placemat) of ways to reduce the amount of garbage in the ocean.</p> <p>Sieving Practice: Using the sieves and bucket of coarse salt and plastic provided, have each group practice how to sieve by putting the salt and plastic mixture in their sieve and running the sieve back and forth to locate the plastic pieces. Have the students place the pieces of plastic they find on individual plates. Have the students compete to see who can collect the most pieces of plastic on their plate.</p> <p>Microplastics Guessing Game: Place out the five vials labelled A-E with the corresponding information card. Students will observe the sample then guess whether or not the sample is a microplastic or not. They will then flip the card over to reveal the answer.</p> <p>Hiding in Plain Sight: Prior to the class, place the products provided (Sample Kit 2) around your classroom so that they are visible but not obvious. Once the students are in their groups, have them read the information about how to identify microplastics in products. When they are finished reading they will then search around the room as a group and record any products or materials which has microplastics in them in their booklet (Page 2).</p> <p>Decide how much time each group should spend at each station before switching. Make sure students have a firm understanding of what station they are heading to next. A diagram on the board, or other visual display is recommended.</p>
Take-Home Homework	<p>Give each student a container and lid with a blank label on it. Have the student put their name on their container as soon as they receive it. Instruct each student that they need to ask their parent or guardian to take them to the nearest park or beach to their house and fill their container with sand and then label where they took the sample from. Ideally the assignment should be assigned on a Friday so they student will have the weekend to complete the task (otherwise give students at least a couple days to complete this task). Write the set date in the booklet (Page 4). Students will need to fill out the <u>Park Characteristics Data Sheet</u> (Page 3). Have the students bring their labelled samples and completed data sheets back to class on the set day.</p> <p>Students will need to have completed the first half of page 3 (either in class or at home) before they begin the data collection on day two.</p>

<p>Day 2 In-Class Activity</p>	<p>Have the students split back up into their assigned groups from the previous day. As long as at least one member from the group has remembered to bring in a sample the activity will work. Each group will get: one sieve, one large bucket, one white plate and one data sheet.</p> <p>Instruct the students to place their sieve over the bucket and slowly pour their first sample into the sieve. Students should remove any organic debris (leaves and twigs) and then slowly begin to shake the sieve back and forth. Once all the smaller particles have gone through the sieve into the bucket, have the students evenly divide the remaining debris in the sieve into each student's plate. Each student will then search for pieces of microplastics visually on their plate with their tweezers. Any recovered microplastics can be picked up with tweezers, or the students can wet the tip of their finger and use their finger to pick up any smaller pieces of plastic. Any recovered plastic is placed in the class Microplastics Recovery Jar provided and recorded on their team's data sheet (Page 7).</p>
<p>Bonus Activity (30-60 minutes)</p> <p>Want to take your microplastic extraction ability to the next level?</p> <p>After the students have visually examined their samples for microplastics, take one of the sample containers and fill it with the sand/dirt from the orange buckets and then show the class the sample and explain that you will be conducting a secondary analysis of the sample. Agitate the sample by lightly turn the sample container upside down and then right side up several times so that the smaller pieces of plastic make their way to the top of the sample. Next, add water to the sample container so that the water line settles approximately 1-2cm above the sample. Using the plastic pipets provided, extract a pipet full of water (squeeze out all the air in the bulb of the pipet, then dip the pipet tip into the water, trying not to touch the sand/dirt sample, then let go of the bulb allowing the water to fill up the pipet). Take a glass slide and carefully place a drop of the water from the pipet onto the slide. Cover the drop of water with a cover slip then set up the slide on the microscope. Focus the sample and start looking for small, often coloured pieces of plastic. Have the students take turns looking into the microscope at the sample.</p> <p>Want to expand on this? After demonstrating this technique, have each group attempt to make their own slide with their own samples.</p> <p>Any plastic pieces observed in the microscope should not be counted in your final microplastic recovery total, however, please include this data in the "Additional Observations" area on the Microplastics Recovery Data Sheet.</p>	
<p>Post-Activity Discussion</p>	<p>After all of the data from each team has been recorded and tallied, share the results with the class. Have a discussion about why certain places may have more microplastic debris than other places and why certain types of microplastic were more abundant than others. If no microplastics were recovered discuss why this may have happened, and suggest new ways to look for microplastics in samples.</p>

	<p>Have the students complete the last part of page 3 in their booklet.</p> <p>Either on your own or as a class, submit your data to the ASC Global Microplastics Initiative at http://www.adventurescience.org/microplastics-sign-up.htm or http://goo.gl/ZhscMA</p> <p>When signing up, please use the Expedition Name “Trash to Treasure” PLUS the name of your school (ex: Trash to Treasure Randerson Ridge). If you have any questions or issues with submitting your data, please contact morgan.attwell@nanaimoscience.org.</p>
Submit Data	<p>Please photocopy all of your data (each group’s Microplastic Recovery Data Sheets and their Park Characteristics Data Sheets) and leave a copy of each sheet in the Teacher’s Sign Out Bucket and return the bucket to NS3. Please go over the Teacher Return Checklist to make sure that all supplies are accounted for and returned with the bucket.</p> <p>We will be keeping all of your data on file. We will also submit all of the data to researchers at Vancouver Island University (VIU) where the data will be used to create a map with microplastic “hotspots” and identify key places to examine further as well as to look into potential sources of the microplastics in those areas.</p> <p>Also please return the Microplastics Recovery Jar WITH any microplastic particles recovered still in it. We will also be sending the recovered microplastic particles to VIU for further studies.</p>
Clean Up	<p>An important part of scientific research when involving data from nature is to be especially mindful of reducing any potential effect that obtaining the data may cause. As such, we suggest a post-activity discussion about proper disposal of materials used to obtain samples. It is important to note to the class that unless samples are altered, it is best practice to return samples to the collection site which they were obtained.</p> <p>Since we are combing samples into one bucket per group due to time and material restrictions, it will not be possible for the students to properly dispose of their samples. It is therefore suggested that the sand/dirt mixture accumulated by each group be spread around the school grounds in an area of similar soil type.</p>

Beach Detectives: Microplastic Investigation

Student Package



Student Name: _____

Group Name: _____

Microscopic Trash

Not all trash is easy to see. Using the microscope, focus on each sample provided, then sketch out what you see in the space below. Don't forget to label your sketches.

Slide Name	Sketch	Additional Notes

Hiding in Plain Sight!

Microplastics are found in many products, some of which might surprise you! In this activity, you will search your classroom for products that contain microplastics. Signs of microplastics include polyethylene or polypropylene in ingredient lists, or 'scrubbing' or 'exfoliating beads' in product descriptions. Another place to look for microplastics is in your clothing! Polyester is a popular material used for clothing which is in fact made of plastic. Every time an article of polyester clothing is washed it can put up to 2000 fibers of microplastic into the ocean!

Record the type of product, and product name, as well as a physical description of the microplastics (if observable).

Type of Product	Product Name	Physical Description
<i>Craft Supplies</i>	<i>Elmer Glitter Glue</i>	<i>Small glittery pieces in glue</i>

Beach Detective – Predictions and Results

Prediction (fill out prior to data collection)

Every good scientist will create a hypothesis, or an ‘educated guess’ about what you think the result of your experiment may be.

In the space below, answer the following questions: How many pieces of microplastic do you think the class will find in the samples you and your classmates bring in? In what areas would you expect to see more microplastic pollution? Which locations would have the least?

Results (fill out after data collection)

Now that you have had a chance to see the results of this experiment, it’s time to compare the results with your hypothesis. Answer the following questions below: How many pieces did your class find? How close was that to your initial guess? Which areas had the most microplastic pollution? What are some sources of error that may have occurred in your experiment?

Beach Detective – Data Collection Methods Sheet

Congratulations, junior scientist! You are officially collecting scientific data which will be used for a world-wide study on microplastics! Make sure to follow the instructions below carefully.

Step 1: Find a date and time that your parent/guardian can accompany you to a local park or beach. When you are all ready to go, make sure to bring this sheet as well as the following items:

- Empty container with lid
- Pen or pencil
- Park characteristics Data Sheet

Step 2: When you arrive at the park or beach, fill out the Park Characteristics Datasheet. Be sure to draw a picture of the area you are sampling.

Step 3: Find an area of the park or beach which has relatively fine sediment (fine sand or dirt). Using your hands, scrape the top layer of sediment into the container until it is full. Put the lid on (make sure it's secure!) and label the container with your name, the park or beach you are sampling from and the date. Bring your sample back to class!

NOTE You should not be digging deeply into the sediment. Try to not penetrate more than a few millimeters into the sediment.

SAMPLES NEED TO BE RETURNED TO CLASS BY: _____

Park Characteristic Data Sheet

Accurate data collection is an important part of any scientific study. There are many factors that could affect the results of your experiment, so it is important to always provide as much information about relevant factors as possible when collecting data. This Beach Characteristic Data Sheet should be filled out when you arrive at the beach you are collecting your sample from. You will use this data to help explain the results of the experiment.

Beach/Park Name:

Date:

Start Time:

End Time:

Weather Condition (be as detailed as possible, e.g., *cold, sunny day with a light breeze*):

Nearest river or stream:

Number of park users at time of sampling (approximate is okay, e.g. *I saw 5 people*):


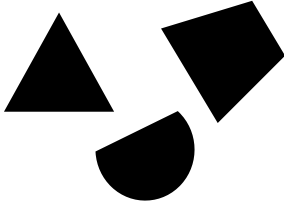
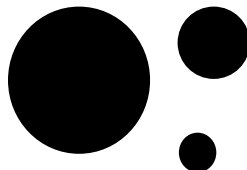
Major recreational use (e.g., *swimming, kites, playground, general, etc.*)

Additional Notes (noteworthy observations, e.g., *saw 3 sea lions swimming near beach*):

Sketch of sampling site (park or beach):

Types of Microplastic

Use the following chart to distinguish between the different types of microplastic that could be found in your samples.


Type	Picture	Description	Commonly Found
Fibre		Small, hair-like strands Often coloured	Polyester clothing or products will shed small fibres every time they are washed
Fragment		Small pieces of plastic with one or more rough corner or area	Fragments are usually pieces of microplastic that have broken off of a larger piece of plastic. Over time fragments will produce many smaller fragments
Pellet		Small, round and smooth pieces of plastic Often referred to as 'nurdles'	Nurdles are commonly used in many household and commercial products.

Beach Detective – Microplastics Recovery Data Sheet

How many pieces of microplastics do you think you can find? In this activity your group will go through a series of steps to try to recover as many pieces of microplastics in your sample as possible.

Steps:

1. Pick one group member to be the recorder. This person will be in charge of recording any microplastic data in your group.
2. Place your team’s sieve over the orange bucket provided and slowly pour your first sample into the sieve. Have the recorder mark down on their data sheet where the sample is from.
3. Remove any organic debris (leaves and twigs). **Slowly** begin to shake the sieve back and forth, ensuring any material going through the sieve is ending up in the bucket.
4. Once all the smaller particles have gone through the sieve into the bucket, evenly divide the remaining debris in the sieve onto each group member’s plate (not the recorder’s).
5. Each group member will search for pieces of microplastics visually on their plate using tweezers. Any recovered microplastics can be picked up with tweezers, or you can wet the tip of your finger with water and use it to pick up any smaller pieces of plastic. Place any pieces of plastic in your individual microplastic recovery vial. Let the recorder know of any microplastic found, what the type is, and where the sample is from.
6. Repeat with each sample until all samples have been sieved. Once all data has been recorded, each member will copy the data written down by the recorder.

	Sample Location	Type of Microplastic (fibre, fragment or pellet)	TOTAL Pieces of Microplastic Recovered BY YOUR TEAM
Example	<i>Departure Bay Beach</i>	<i>2 x fragment 1x pellet 2 x fibre</i>	
1			
2			
3			
4			

Additional Observations:

Teacher Return Checklist

Materials in Kit:

- 6 Sieves
- 30 Animal Cards
- Samples of microplastics of various sizes (Sample Kit 1)
- One 10x Magnification Microscope
- 9 prepared microscope slides
 - 3 Sand (Slide 1)
 - 3 Microplastic (Slide 2)
 - 3 Sand and Microplastic (Slide 3)
- Microplastics Guessing Game (5 vials labelled A-E)
- Products with Microplastics (Sample Kit 2)
- Large sheets of paper (for Placemat Activity)
- Bucket of salt with microplastics
- Five small strainers
- 30 containers with lids
- 6 large buckets
- 30 tweezers
- 50 white plates
- Microscope slides and slide covers
- Coffee filters
- Eight Crayola markers
- Please also include any extra copies of Beach Detectives: Microplastic Investigation Student Package
- Completed Beach Detective – Microplastics Recovery Data Sheet from each group
- Completed Park Characteristics Data Sheets from each group
- Microplastics Recovery Jar containing all extracted microplastics

****Please place data sheets in envelope provided****

Teacher Name: _____

School: _____

Date: _____

Class Total Number of Microplastics Extracted: _____

Have you submitted your data to ASC Global Microplastics Initiative? Yes / No