HOW MUCH PLASTIC IS IN OUR OCEANS?
Understanding Plastic Pollution

Plastic pollution is very harmful to our environment because it is dangerous to animals, disrupts ecosystems, and never fully disappears. Plastic does not decompose, it only breaks down into smaller pieces, called microplastics. Microplastics can be incredibly harmful to animals, when they ingest the extremely small plastics it could cause them to starve because their stomachs feel full, yet they are not receiving the proper food or nutrients they need to survive.

Have you ever wondered just how much plastic there is in our oceans? Well, if you have, you are not alone. A team of researchers from Canada and Australia wondered the same thing. Dr. Stephanie Avery-Gomm, Dr. Jennifer Provencher, Dr. Max Liboiron, Dr. Paul Smith, and Florence Poon, conducted a study that looked at how much plastic pollution was in the Labrador Sea.

Why Did the Researchers Focus on the Labrador Sea?

The research team chose to examine the Labrador Sea because no one else had! The amount of plastic in the Labrador Sea was a mystery until the researchers took on the challenge. The Labrador Sea is found between Newfoundland and Labrador in Canada, and Greenland, and it is important because its ecosystem is of great value to these regions' economies. There are also many species which call the Labrador Sea home.

The Labrador Sea is not often travelled for leisure, so the researchers hypothesized that there would be minimal pollution due to minimal human activity. However, the researchers suspected that the area was at risk of pollution. Climate change has caused temperatures and sea levels to rise which has made it easier for pollutants to invade the sea. The Labrador Sea's vulnerability made it an important area to study for the research team. The researcher’s efforts revealed that there is a considerable amount of plastic in the region. This information is concerning as it leads us to wonder just how much plastic there is in higher-traffic areas than the Labrador Sea.

What Did the Research Team Find?

The team's goal was to find out how much plastic was in one of the Labrador Sea's seabird species, the Northern Fulmar, so that they could better understand the amount of plastic pollution in the ocean. A baseline measurement, also known as the before or initial measurement, was important to gather first in order to see what they were dealing with, and second, to allow the research team to observe any changes in marine plastic pollution in the future.

The researchers measured the amount of plastic in the Labrador Sea through a process called biological monitoring. Biological monitoring allows scientists to measure a predetermined harmful substance by examining a biological sample. In this case, the harmful substance is plastic, and the biological sample is the Northern Fulmar. The amount of plastic found in the stomachs of the Fulmars is a representation of how much plastic is in the area where the birds fly and live.

The Northern Fulmar has been utilized in plastic pollution monitoring initiatives since 2003, hence why the research team selected it for this study. Classified as a surface-feeding seabird, the Fulmar has similar features and colouring to a seagull. It is a reliable monitor in Northern areas because its travel patterns and feeding routes allowed the researchers to examine a specific area. Most importantly, the Fulmar’s digestive system is tough. Rather than regurgitating the plastic when they eat it, they ingest the plastic and break it down into small enough pieces that it can travel into the small intestines.

Over two years the researchers monitored the bodies of seventy Northern Fulmars. They found that 79 percent of the birds had ingested plastic with an average of 11.6 pieces. The research team took this data and compared the amount of plastic in Fulmars of the Labrador Sea with the Ecological Quality Objectives (EcoQOs). The Ecological Quality Objectives are indicators that aim to make the North Sea a safer environment for marine life. One of the objectives declares that Fulmars should not have more than 0.1 g of plastic in their stomachs. According to the study, 34 percent of all Fulmars exceeded the EcoQO for marine litter, having ingested more than 0.1 g of plastic.

Although the Labrador Sea has low levels of plastic pollution, efforts need to be made to meet the standards of the EcoQOs. By understanding how much plastic is in the environment, we can be better prepared for the dangers it may cause. We can also use baselines to determine if our effort to reduce plastic pollution is working. If we put new practices into place and plastic pollution still rises, we know they are not effective.

Northern Fulmar Fact:

When threatened, Northern Fulmars have an effective defense: a vile-smelling stomach liquid that the birds can spray out of their mouths for several yards.

It is a good reason to keep your distance from nesting birds! 4

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4. Ibid.
What Can We Do to Reduce the Plastic in Our Oceans?

One of the main things we can do to reduce the plastic in our environment is to reduce our plastic usage by only choosing to use plastic when it is absolutely necessary. Take a second to think about how much plastic you use in your everyday lives. If you are having a hard time imagining this, take a walk through your house and take note of all the plastic you see. Remember – reduce, reuse, or refuse. Can you reduce the amount of plastic you are using so you are using less? Rather than throwing something out, try to think of a way to reuse it. Or instead, if using plastic in the first place, refuse it! When we are mindful about our use of plastic, we reduce the number of new plastic items circulating in our environment and the need for plastic products.

Another way to make sure that plastic avoids going into our oceans is to properly dispose of waste - recycle. Each neighbourhood has a different way of sorting waste. It is important that we as citizens take the time to properly dispose of our garbage. Whenever you see plastic in nature or your neighborhood, collect it and check if you can recycle it.

Plastic pollution is not only harmful to animal life, it is harmful to human lives too. Reducing plastic pollution in our oceans will help mitigate some of the impacts of climate change.

Water Filtration Activity

Recommended for Science, Grade 7 (Environmental Action), Science, Grade 7 (Engineering Structures)

Recommended with modifications: Oceans 11 (Module 1: Structure and Motion)

Activity Summary

Learners will construct wastewater treatment plants to understand how plastic pollution makes its way into our oceans. Learners will also gain an understanding of the scale of microplastics and thus, how they are dangerous.

Learning Goals

1. To understand how wastewater systems contribute to plastic pollution in our oceans.
2. To formulate a plan that will help improve wastewater systems.
3. To gain exposure to environmental engineering.

Introduction

Wastewater systems are central to all communities; they help us recycle and clean our water so that it can go safely back into our oceans, rivers, and lakes. Straws and microplastics often fall through the cracks and filters of these systems and end up in our oceans. To stop plastic and other pollution from entering our oceans, we must take action to stop it at the source.

Materials

Set-up Materials (per group)
- Two 2-litre clear plastic bottles (ask students to bring these from home)
- Craft knife
- Safety goggles (one pair per student)
- Rubber gloves (one pair per student)
- A set of measuring cups
- One mixing bucket filled with roughly one litre of tap water
- Paper and pencils
- Tape
- Brown paper or/and paper towel for clean up
Pollution Mixture (per group)
- One small container of cooking oil (approximately \( \frac{1}{4} \) cup per group; representing oil from oil spills)
- One small container of coffee grounds (approximately \( \frac{1}{4} \) cup per group; representing industrial runoff or waste)
- Bag of very small pieces of plastics, for example plastic beads (one tbs per group; representing naturally broken up microplastics)
- Straws cut up into small pieces (two straws per group)
- Glitter (one tsp per group; representing small microplastics)

Filter Materials (per group)
- Two coffee filters
- One cheese cloth
- One small net
- One bag of pebbles or gravel
- Activated Charcoal (if you can buy this locally, often found at pet stores)
- Elastic band

Optional: Water Testing Tools (to share with the whole class)
- Materials for water quality testing, such as turbidity, pH, dissolved oxygen, nitrogen, phosphorus, conductivity, or any other available tests which suit the needs of the curriculum. PASCO sensors could include wireless temperature, conductivity, and CO₂ sensors.
- Water quality testing kit (available at Canadian Tire, on Amazon)

Methods
1. Split up into groups of four or five.
2. Have a flat surface to complete the activity. Cover a working area with brown paper or paper towels.
3. Have a discussion about what each pollutant represents and what problems they can cause.
4. Lay out all the pollutants, the mixing bucket with water, and the two 2-litre bottles.
5. Once your group has all of the necessary equipment, mix the pollutants with the water in the mixing bucket. (Pollutants can be pre-measured so that you only need to dump them into the water mixture.)
6. Cut off the top portion of one of your water bottles where it begins to taper. Cut off the bottom of the second bottle where it begins to bulge. The cut ends should now be equal in diameter.
7. Discard the short ends that have been cut off each bottle.
8. Turn the bottle with the top cut off so that the mouth is faced down into the other bottle.
9. Using as many of the filtering materials as possible, create layers with the different materials on the inside of the mouth of the bottle. You may want to use tape to add extra stability.
10. Record which materials you use and draw a diagram of your filtration system.
11. Once you have created your filter, use the measuring cups to scoop the polluted water into the open end of your system. The bottom bottle will collect the clean water.
12. Once the polluted water has been poured through the filtering system, you can then examine the filtered water and compare with other groups.
13. As a large group, develop a mock EcoQO set of standards that defines what makes the water acceptable. Follow the scientific method:
Observe: Where does the trash that enters our waterway end up? Is plastic pollution visible on nearby shorelines? How much? What seems to be the most common items?

Research: What are the current systems in place, locally, for filtering out trash?

Hypothesis: What will be the most difficult size of grain to filter out? Will you be able to filter out all of it? How much do you think will remain unfiltered?

Experiment: Test the wastewater treatment systems created by the groups. Run a control experiment with tap water and record the results. Make sure that all observations are recorded, even ones that seem unrelated. Repeat the experiment with the “waste” water.

Analyze data: Have all groups share their models and their results. If available, use the water quality tests and record data. What worked? What did not? What does the data mean?

Repeat: Create a second treatment system, keeping in mind the collected data from the first experiment.

Conclusion and report: What was discovered during this experiment? Did the results line up with the initial hypothesis? How could the experiment be improved if it were to be repeated? What are some possible errors which could have occurred during the experiment changing the results?

Discussion Questions

1. What was the biggest challenge when constructing your wastewater treatment plant?
2. What materials were the most difficult to remove from the water?
3. What filters were the most effective?
4. Do you think environmental engineers are faced with similar challenges in the real world?

Questions for the Future

What questions did the activity leave you with? How could you find the answers?


Water Filtration Activity

Name: _________________________________________

a. **Observe**: Where does the trash that enters our waterway end up? Is plastic pollution visible on nearby shorelines? How much? What seems to be the most common items?

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b. **Research**: What are the current systems in place, locally, for filtering out trash?

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c. **Hypothesis**: What do you think will be the most difficult size of grain to filter out? Will you be able to filter out all of it? How much do you think will remain unfiltered?

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d. **Experiment**: Test the wastewater treatment systems you and your peers have created. Run a control experiment with tap water and record the results. Make sure that all observations are recorded, even ones that seem unrelated. Repeat the experiment with the “waste” water.

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e. **Analyze data**: Have all groups share their models and their results. If available, use the water quality tests and record data. What worked? What did not? What does the data mean?

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f. **Repeat**: Create a second treatment system, keeping in mind the collected data from the first experiment.

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g. **Conclusion and report**: What was discovered during this experiment? Did the results line up with the initial hypothesis? How could the experiment be improved if it were to be repeated? What are some possible errors which could have occurred during the experiment changing the results?

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