Science Unit: *Marine Pollution*
Lesson 4: *Plastic Pollution*

School year:	2006/2007
Developed for:	David Oppenheimer Elementary School, Vancouver School District
Developed by:	Sara Harris (scientist), Liza Archer and Scott Lundell (teachers)
Grade level:	Presented to grades 4-5; appropriate for grades 4-7 with age appropriate modifications.
Duration of lesson:	1 hour
Notes:	Part of this lesson is a follow-up after a field trip to the Iona wastewater treatment plant and the nearby beach (see Lesson 3, Iona Wastewater Treatment Field Trip in the Marine Pollution science unit, Earth Science curriculum area, available from the Scientist in Residence Program website http://www.scientistinresidence.ca).

Objectives

1. Practice using math to average scientific data.
2. Practice using math to extrapolate scientific data to a larger area than sampled.
3. Use samples and data collected on a field trip to estimate the amount of plastic pollution in our area.
4. Learn how plastic pollution can affect marine wildlife.

Background Information

Since scientists are unable to sample the entire world, they sample small areas and then extrapolate their results to larger areas. On the beach field trip (previous lesson), we sampled small areas of the beach, defined by quadrats, and gathered samples of plastic pollution from inside the quadrats. We have replicates of the beach samples because each pair of students sampled a slightly different part of the beach. Scientists gain confidence in their data by sampling in multiple similar locations, then averaging the data. Then, they may choose to extend those results to similar environments that were not sampled, which we will do here.

In British Columbia, we have about 27200 kilometers of coastline (this is a rough estimate!). In this lesson, we'll consider the "coastline" to extend inland by 10 meters (also a rough estimate!) from the water line, giving us a coastal "strip" of 272,000,000 square meters of coast in B.C.

Marine wildlife interacts with plastic in a variety of ways, many of them harmful. They can become entangled, or they can mistake the plastic for food, fill their bellies with plastic, then starve. In some situations, plastic pollution can also be beneficial to marine wildlife, for example, providing shelter or hiding places. Plastic can last for decades in the marine environment before disintegrating.

Vocabulary

Quadrat:	A square frame (made of any rigid material), usually 1 meter on a side.
Plastic:	Synthetic (human-made) material that can be soft or hard and can be shaped and molded. Plastics are typically made from hydrocarbons plus chlorine, and are usually less dense than water, so they float in the ocean. Examples: plastic bag,

yogurt container, “rubber” duckies.

Pollution: A substance or waste product that is harmful to the environment in which it’s found.

Replication: Repeating observations or measurements, in this case, in a slightly different place. If your replications agree, then you gain confidence that your observations are representative. You can average your replications to gain more confidence.

Extrapolate: Extend observations to similar areas that were not sampled.

Entanglement: When an animal becomes tangled with some item (e.g. net, line, six-pack ring) from which it cannot escape by itself.

Materials

- Samples of plastic collected during the beach field trip
- Images of marine wildlife with plastic problems, e.g. seal with six-pack ring, right whale with fishing gear, albatross skeleton with plastic inside, fish and other marine life hiding under a floating plastic object.
- Copies of data sheets, one per student
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- Calculators, if needed
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In the Classroom

Introductory Discussion

1. What is plastic pollution? Where does plastic pollution come from? What things do we use that are made of plastic? When does an item become “pollution”?
2. Discuss transport of plastic. How does plastic get into the ocean? You could do a demo with a fan (wind) and/or with water running down a slope (rain). How does plastic get onto the beach, where we found it?
3. How does marine life interact with plastic in the ocean or on the beach?
4. Discuss vocabulary.
5. Discuss math: averages and extrapolation.
6. Briefly describe activity.
7. Review scientific method, particularly data analysis, interpretation, and conclusions.

Science Activity/Experiment

Activity Title: Interpreting plastic pollution in the oceans

Purpose of Activity: Explain sources of plastic pollution to the ocean. Use data to extrapolate a small sampling area to a large sampling area. Examine and interpret images of wildlife interacting with plastic items.

Experimental Observations: This is not an experiment with controls and treatments. Students will analyze their own observational data and data from other sources.

Methods:

Set-up prior to experiment: Distribute samples of beach plastic from the field trip back to the students who collected them.

Students will work in groups of 2 (a few groups of 3 is fine). In their lab notebooks or on the data sheets, they should record today's date and lesson title.

1. Distribute students' sample bags back to them. Examine samples (they can do this by looking through the clear plastic bag). Can you identify the source of each of your pieces of plastic? How many are identifiable? How many are unidentifiable?
2. Calculate the average concentration of plastic pollution at Iona beach.
    a. Each pair of students should have some data from the Iona beach field trip. The data are number of pieces of plastic found within one quadrat.
    b. On the blackboard or flipchart, write down each pair's data.
    c. Students calculate the AVERAGE concentration of plastic on Iona beach. Units will be pieces of plastic per quadrat. You may end up having a discussion of big versus small pieces.
    d. Ask students how many pieces of plastic they think are on all the shorelines of British Columbia, all combined. Write student guesses on the board.
    e. British Columbia's coastline is about 27200 km long, including coastlines of islands. Assume that the "beach" extends 10 m inland from the water. This gives us a "coastline area" of about 272,000,000 square meters of beach in B.C. Extrapolate student data to calculate the TOTAL number of pieces of plastic on the coastline in British Columbia. (If your quadrats are not actually 1 square meter, you may choose to have students figure out how many quadrats would cover the coast of B.C.)
    f. Discuss whether Iona Beach is representative of most coastlines in B.C. Urban/not urban, sandy vs rocky shoreline. Ask students what the shoreline is like at different places they've been.
3. Set out images of wildlife interacting with plastic pollution, or show the images to the full group, one at a time.
    a. Ask students what's happening in each image. Is the plastic harmful or beneficial to the animal in the image? How has the situation in the image come about? What might happen next? This is an exercise in interpreting observations.
    b. You might choose to have the students write down their reactions to these images.

Closure Discussion

1. What can you do to decrease plastic pollution in the oceans and on the beach?

References

1. http://www.marine.usf.ude/beachbuddies for lessons and background information about marine debris.
2. http://www.ocean.udel.edu/mas/masnotes/plastic.html for information about boaters and marine plastic pollution.
3. http://www.conservationinstitute.org/ocean_change/ocean_pollution/ for marine debris information and images of marine wildlife and plastic.
4. http://www.mindfully.org/Plastic/Ocean/Moore-Trashed-PacificNov03.htm for image of albatross skeleton with swallowed plastic inside

5. http://www.environment.gov.au/minister/env/2004/mr10mar04.html for information and a few images
6. http://www.marinephotobank.org/secure/gallery.php?gallery_id=3&click=1 for MANY images of marine life interacting with pollution, including plastic. You have to set up a login (free).
7. http://video.google.com/videoplay?docid=3892310789953943147 link to "Alphabet Soup" video documenting plastic pollution in our oceans.

STUDENT DATA SHEET – Plastic Pollution

Name_____ **Date**_____

<u>Iona Beach Samples:</u>

1) **How many pieces of plastic did you find in ONE QUADRAT at Iona Beach?** _____

2) **Examine your samples of plastic from Iona Beach. Where do you think each of them came from?**

How many of your pieces are identifiable? _____ **How many are unidentifiable?** _____

3) **What is the AVERAGE plastic concentration at Iona Beach? (Use everybody's data)**

4) **If we extrapolate our data to the ENTIRE coastline of British Columbia, how many pieces of plastic are lying on beaches in our province? Assume that your quadrat is one square meter, and that there are 272,000,000 square meters of coastline in B.C.**

5) **Do you think most of the coast of B.C. is like Iona Beach? Why or why not?**

6) **Is our estimate of the total number of pieces of plastic on the B.C. coast a good estimate or not?**